DYNATEC
MINING LIMITED

CANADA CENTRE FOR MINERAL AND ENERGY TECHNOLOGY,
ENERGY, MINES AND RESOURCES CANADA.

CANADIAN MINING INDUSTRY CAPITAL AND OPERATING INDICES
(OPEN PIT AND UNDERGROUND)

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Project No: E074
April 18, 1985
Dynatec Mining Limited
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CANADIAN MINING INDUSTRY CAPITAL AND OPERATING INDICES
(OPEN PIT AND UNDERGROUND)

FINAL REPORT
BY:

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Work on the project was conducted under the auspices of the Canada Centre for Mineral and Energy Technology, Energy, Mines and Resources Canada.

DSS FILE NO.: 14SQ.23440-4-9136
DSS CONTRACT SERIAL NO.: OSQ84-00341
CANMET PROJECT NO.: 440251
CANMET SCIENTIFIC AUTHORITY: MR. R. CLARKE

DATE: MARCH, 1985

157 pp

MICROMEDIA

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April 16, 1985

Mr. R. Clarke
Energy Mines & Resources
CANMET, Mining Research Lab.
555 Booth Street
Ottawa, Ontario
K1A 0G1

Dear Mr. Clarke:

Re: Canadian Mining Industry Capital
and Operating Indicies (Open Pit & Underground)
DSS File No.: 14SQ.23440-4-9136

We are pleased to enclose, herewith our report on the above subject, prepared in accordance with your instructions and our contract with the Department of Supply and Services (Contract Serial Number OSQ84-00341).

We look forward to reviewing this report with you and your colleagues in Ottawa. We wish to thank Mr. D.B. Gladwyn, Mrs. M. Brock and yourself for the assistance and co-operation received in carrying out this assignment.

Yours truly,

DYNATEC MINING LIMITED

J.B. Scott, P. Eng.
Projects Manager

JBS:cym
Enclosure

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ACKNOWLEDGEMENT

This work was reviewed and critiqued by senior staff from Lac Minerals Limited and Dome Mines Limited. Dynatec Mining Limited and Energy Mines and Resources, Canada, are grateful to these two companies for the valuable contribution they made to this final report.

SUMMARY

1. Capital and Operating Costs have been prepared for a 2,500 tpd gold mining operation located in Ontario. The mine uses both Mechanized Cut and Fill (MCF) and Blasthole Stoping (BHS) methods to achieve the required production. A number of figures illustrate the required mine development, and mining operations.

2. The data input to this report and those data generated have been assembled on a computerized data base which has been supplied with this report.

3. Operating costs estimates were prepared on a 'first-principles' basis by calculating quantities of work for main activities and sub- activities, applying productivity factors to determine manpower and equipment requirements, and using unit costs for labour and supplies/ services.

4. The attached tables summarize the Capital and Operating Costs for both mining methods used in this operation.

5. It is hoped that this document and the associated data base material will provide a stimulus to CANMET and other Energy Mines and Resources agencies to develop a wider range of realistic costs applicable to the Canadian Mining Industry. The work carried out for this report is a very preliminary step in developing a comprehensive data base of Canadian mining costs. Dynatec Mining Limited feels that on-going work could be carried out on the following topics, all of which can be assisted by reference to this report.

   - preparing costs for a wide range of production rates, mining methods, geographical locations, geotechnical conditions, etc.

   - developing a cost estimating model for capital and operating costs in Canadian mining

   - devising a means to regularly update costs to take account of inflationary factors and technological advancement

GOLD MINING OPERTION, ONTARIO
TOTAL DAILY PRODUCTION
CAPITAL COST SUMMARY

ITEM		INITIAL COSTS $
Mining Equipment		3,458,000
	MCF Section (1,333 tpd)	
Mining Equipment		3,735,000
	BHS Section (1,167 tpd)	
Surface Facilities		17,682,000
Pre-Production Development		
	Shaft Sinking Materials	1,425,520
	Contractor Services	6,461,000
Mine Services		
	Materials and Equipment	4,646,000
	Underground Construction	2,091,000
Lateral Development		
	Materials	3,406,000
	Contractor Services	23,869,000
Waste Passes, Ventilation Raises		
Raiseboring Contractor Services		1,650,000
TOTAL CAPITAL COST		68,423,520

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GOLD MINING OPERATION, ONTARIO
TOTAL DAILY PRODUCTION 2,500 TONNES
UNIT OPERATING COST SUMMARIES FOR
BOTH MINING SECTIONS
($/+ ORE)

ACTIVITY	MCF SECTION (1,333 tpd)			BHS SECTION (1,167 tpd)		
DIRECT	LABOUR	SUPPLIES	TOTAL	LABOUR	SUPPLIES	TOTAL
Mine Development	0.44	0.238	0.678	0.52	0.238	0.758
Stope Development	2.14	0.930	3.070	1.70	0.963	2.693
Stope Drilling 51mm	0.62	0.608	1.228	-	-	-
Stope Drilling 110 mm	-	-	-	0.55	0.431	0.981
Stope Blasting	0.29	0.593	0.883	0.19	0.620	0.810
Stope Mucking	0.68	-	0.680	0.44	-	0.440
Secondary Blasting	-	-	-	0.52	0.571	1.091
Ground Control	1.56	1.019	2.579	0.33	0.153	0.483
Backfill	0.39	0.713	1.103	1.14	0.378	1.518
Roadbed Maintenance	0.23	0.004	0.234	0.26	0.004	0.264
Underground Jaw Crusher	0.41	0.060	0.470	0.47	0.060	0.530
Conveying	0.31	0.011	0.321	0.35	0.011	0.361
Hoisting	1.07	0.185	1.255	1.22	0.185	1.405
Mine Services	2.30	0.393	2.693	2.54	0.393	2.933
Fuel	0.08	0.555	0.635	0.09	0.624	0.714
Tires	0.08	0.293	0.373	0.09	0.328	0.418
Mine Air Heating	-	0.597	0.597	-	0.671	0.671
Pumping	0.08	0.003	0.083	0.09	0.003	0.093
Electric Power	0.41	0.789	1.199	0.47	0.789	1.259
Ventilation	0.16	0.038	0.198	0.19	0.038	0.228
Rail Haulage	0.33	0.088	0.418	0.38	0.088	0.468
Ore Passes	-	0.035	0.035	-	0.035	0.035
Diamond Drilling	-	0.986	0.986	-	0.986	0.986
Maintenance Supplies	-	1.885	1.885	-	2.154	2.154
SUB	11.58	10.023	21.603	11.57	9.728	21.298
INDIRECT						
Management & Engineering	0.793	1.617	2.410	0.793	1.617	2.410
Operations Supervision	0.583	-	0.583	0.583	-	0.583
Maintenance Supervision	0.291	-	0.291	0.291	-	0.291
SUB	1.667	1.617	3.284	1.667	1.617	3.284
TOTAL	13.247	11.640	24.887	13.327	11.345	24.582

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PART 1
INTRODUCTION

1.1 STATEMENT OF WORK

This report was prepared under Contract No. OSQ84-00341 with the Department of Supply and Services following submission of a proposal dated August 3, 1984 and a subsequent supplement dated December 18, 1984 addressing a substantially reduced scope of work.

The work consists of preparing cost estimates for an underground mining operation producing up to 2,500 tonnes per day from a narrow vein ore body within a reasonably competent host rock. A subsequent amendment to the contract included the provision of computer hardware and software packages for storing and making future modifications to the information presented herein.

1.2 APPROACH TO PROJECT

1.2.1 GENERAL

The costs presented in this report are based on estimates recently prepared by Dynatec Mining for a private mining company. The mining scheme represents one of a number of proposals considered and costed for that client. The particular mining plan is realistic and, while the mine is not yet operational, it could be developed and operated in the way suggested.

The cost estimates have been prepared on the basis of Dynatec's experience with similar operations, the client's experienced costs for certain activities and manufacturers' and suppliers' quotations.

We believe the costs to be realistic for the operation proposed but, of course, must stress that they relate to one particular mining plan which could never be applied to any other property. The procedure for developing the estimate is, however, valid for any underground mining operation and could be used as a model for preparing estimates for other mining properties.

1.2.2 BASIS FOR PREPARATION OF COSTS

.1 General

A mine operating budget has been development for an underground gold mine. Each major repetitive work item of the mining operation has been costed separately in some detail. Non-repetitive items such as capital costs and pre-production development have been presented in this report but without detailed back-up. The principles used to develop estimates for such work are exactly the same as for the on-going work which has been covered in detail.

There should be sound reasoning to support the development of monetary values for items of work planned in the future. Accordingly, budgets and estimates must be made on a logical, sequential basis.

.1 General (Cont'd)

When accurate take-offs of the quantity of work to be performed are combined with productivity data and valid costs for labour, materials and supplies, a cost estimate is developed. A mine operating budget is essentially an estimate of expenditures under various categories during a particular period of time. Estimates and budgets are usually divided into various categories under one of the main headings of Capital Costs and Operating Costs. The classification into one or another of these headings usually presents no problems as tax laws are unequivocal in categorizing various expenditures. Sometimes, however, disputes do arise on the correct category to apply for some aspects of development work. The mining company seeks to expense the maximum amount, whereas the taxman may want to see certain development work capitalized.

.2 Quantities

As mentioned above, the first task is to measure the quantities of work to be carried out in a given period of time for each element and sub-element of work which is to be costed. This involves calculating basic linear, superficial and volumetric quantities from the mining plans. From these basic measurements, subsidiary quantities are derived. For example, development headings are initially measured on a linear basis for all those headings of the same cross sectional area. These two units are combined to give the neat volume of material to be excavated. Subsidiary quantities for this particular activity can include, the number of holes to be drilled, the length of each hole and hence, the total drilling; the quantities of explosives and accessories, the volume of blasted muck, haulage distances to dumping locations, ground support quantities and many more. When all the costs relating to these items have been derived, they are often divided by the original quantity (in this example length of a particular sized heading) to give a unit cost for that item (dollars per metre in the example). Part 3 of this report develops the quantities required for preparing the budget including the following elements:

Permanent materials.
Temporary materials.
Individual major work elements.
Subsections of major work elements.
Equipment maintenance.

.3 Production Elements

The development of reliable performance criteria for the range of operations required for mining is usually by a combination of scientific evaluation and engineering judgment. The most valuable input to this process is experienced productivities at the same or a similar operation. However, it must be recognized that, even if the budget is being prepared for a long-established operation, with good

.3 Production Elements (Cont'd)

records of past-performance, it is only an estimate of future results. The factors that affect various performances in mines include the following:

1. The general state of the economy.
2. Geographic location.
3. Physical conditions (geological, geotechnical, temperature, water, etc.).
4. Individual labour skills and experience.
5. Labour crew compatibility.
6. Supervisory skills.
7. Wage rates and incentive programs.
8. Equipment availability type, applicability and manufacture.
9. Maintenance facilities.
10. Availibility of spares.
11. Quality of supplies and materials.

It is not surprising that with such a vast range of variables the performances achieved by a similar crew and equipment at different operations can vary by orders of magnitude as a result of one or a combination of the above factors.

Part 4 of this report develops production elements for each operation. The labour and equipment resources required to carry out all the mining activities are calculated in this Part of the report for one day's production.

.4 Cost Elements

As discussed above, costs have been presented under the two main headings of Capital and Operating Costs covered respectively, in Parts 5 and 6 of this report. For convenience, these costs have been presented on a variety of unit bases in Part 7. Finally, we have carried out a number of sensitivity analyses to identify the effect on costs of changing key input variables.

.41 Capital Costs

Capital Costs have been sub-divided into the following categories:

Mining equipment purchases (including replacements).
Surface facilities.
Pre-production mine development.

We have presented costs in some detail under each of these categories but they were not developed on a "first-principles" basis. The sources of information for these costs are given in Part 5.

.42 Operating Costs

Operating Costs have been developed in Part 6 of the report. They comprise costs of all labour, materials and equipment operation required on an on-going basis. This is one area where different companies frequently classify the costs in different ways. The following cost elements must be covered under this heading.

Labour (wages and burdens)
- hourly paid
- supervisory
- management
- consultants
- equipment maintenance.

Materials
- permanent materials
- supplies and services
- equipment operating expense
  - tires and trucks
  - repair parts
  - fuel, oil, grease.

Although all these various elements must be included in all budgets and estimates, their allocation often varies from one mine operator to another. For example, one company may not attempt to allocate indirect labour such as management and supervision to specific tasks whereas another company will. Certain supplies may not be allocated to particular tasks, expecially those supplies which are used for a number of different activities such as fuel, oil and grease.

It is thus important when comparing "costs" from different mines to verify first that the elements constituting these costs are equal in each case. Unless this can be done satisfactorily at the outset, cost comparisons are, of course, meaningless.

.43 Unit Costs

Part 7 of this report presents the cost data developed in the previous parts as a series of unit costs expressed in a number of useful ways. It is often valuable when evaluating alternative approaches to a mine plan to utilize unit costs developed on different bases. For example, in considering alternative mine access methods, it is more valuable to use the costs of shafts and ramps on a linear basis ($/m) rather than costs expressed in absolute terms or expressed as a unit per tonne of ore produced.

.44 Sensitivity Analyses

The effect that changing the costs of certain key input variables would have on the costs of producing the ore have been addressed in Part 7. These analyses permit a quick identification of the most important variables for a particular type of operation.

.44 Sensitivity Analyses (Cont'd)

They also show areas in which to focus for potential cost savings.

1.3 FUTURE REFINEMENTS

Insofar as CANMET's original request for proposals sought to collect cost information on all of Canada's existing surface and underground mining operations, the figures presented herein have merely scratched the surface in addressing such a wide subject. However, this report does show the complexity of preparing reliable costs and operating budgets. The data presented in this report illustrate just one way in which costs are developed for a typical mining operation. Whereas, the principles and fundamental components of every budget are similar, the actual numbers and, more particularly, their groupings will change significantly from one operation to another.

We would welcome the establishment of a uniform costing system for the Canadian Mining Industry and feel that this work and the feedback which it may generate constitute a very preliminary step in that direction. We believe that a uniform costing system would be of invaluable benefit to mine operators, consultants, students, research organizations and government authorities.

The development of such a system and the collection of further cost data could be approached simultaneously as one aspect clearly complements the other.

1.4 DATA BASE MANAGEMENT SYSTEM

The data used in preparing the estimates presented herein and those generated by this work have been stored in computer files which have been presented with this report. By this move, we have made the first step in developing a data base for operating costs in Canada's mining industry. We believe this could be added to substantially, over the years and kept current by developing certain updating procedures.

More information on the management system is included in the text files supplied on the diskette with the data base. The "READ.ME" file is the introduction and the key to the files. The software has been developed to permit ready access to the data prepared for this report as well as provisions to add data from other mines with different mining methods, production rates, location, etc.

PART 2
DESCRIPTION OF MINE

2.1 INTRODUCTION

The proposed gold mine from which these cost estimates and operating budget have been developed is located in Ontario. The reserve inventory for the underground mine has changed on a number of occasions depending on geological criteria used. The mining plan and associated cost estimates relate to only one of the several geological interpretations which have been developed on an on-going basis and which are still proceeding.

In planning the mining operation, the designers were given the following key criteria:

1. Mining rate 2,500 tpd.
2. Project should have low capital costs.
3. Mining methods should have low operating costs.
4. There should be flexibility for future expansion to 4,000 tpd.
5. There should be some opportunity for exploration, diamond drill or bulk sampling at an early stage in the underground development program.

A longitudinal section of the mine, is shown on Figure 2-1. Several procedures for developing and mining the ore body were devised but this report is based on a single proposal. It was decided that between the 9th and 5th Levels mining would be by the Mechanized Cut and Fill Method. The remaining ore, from the 11th to the 9th Levels and from the 5th to the 3rd Levels would be mined by Blasthole Stoping.

Dynatec prepared operating cost estimates for the two methods selected, a manpower schedule for underground work force and an underground mining equipment list. This work formed the basis for preparing this report.

2.2 GEOLOGY

The gold property is accessed by an all-weather road. In general, three geological environments for gold mineralization were observed. The zone considered for mining has an average horizontal strike length of approximately 300 meters and an average horizontal width of 11 meters.

The hanging wall consists of a competent basaltic rock with no persistent foliation plane.

2.3 ORE RESERVES

The calculated reserves were sufficient to support a mining operation of 2,500 t per day for several years.

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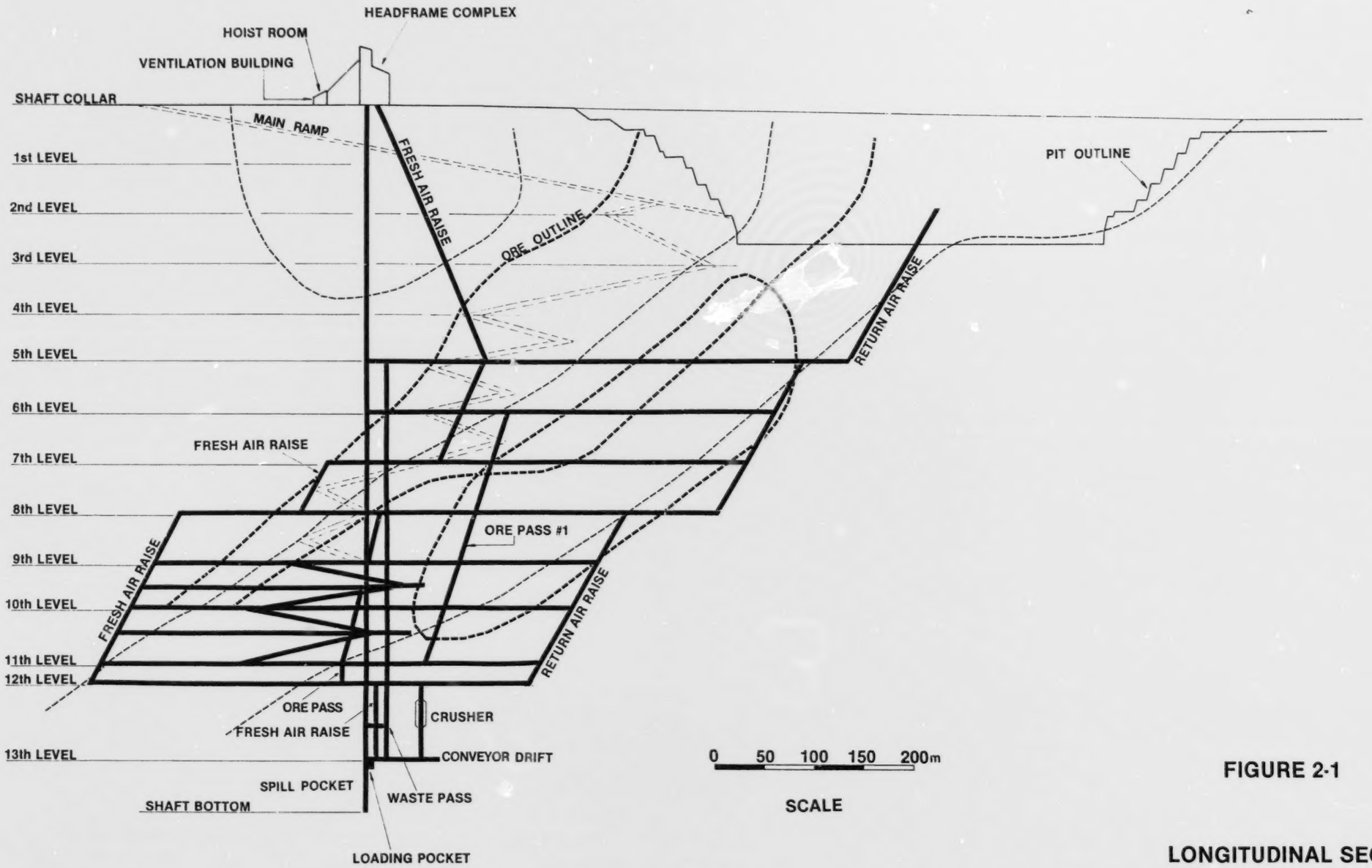

FIGURE 2-1

LONGITUDINAL SECTION
OF MINE

2.4 UNDERGROUND MINING

2.4.1 GENERAL

For mining purposes the ore in the mining zone has been divided into three blocks as shown on Figure 2-1:

Block	Levels	Mining Method
A	Above 5th	Blasthole with Delayed Fill
B	5th to 9th	Mechanized Cut and Fill
C	9th to 11th	Blasthole with Delayed Fill

Block A ore is located above the 5th Level and is considered to be suitable for mining using sub-level blasthole, with delayed fill stoping methods.

Block B ore is located between the 9th and 5th Levels. Because of the low dip angle, Block B ore cannot be mined using bulk mining (gravity-flow) methods. Therefore, mechanized cut and fill has been selected as the mining method for this block.

Block C ore is located between the 11th and 9th Levels and is also considered suitable for mining using sub-level blasthole with delayed fill stoping methods.

In order to achieve the desired production rate of 2,500 tpd, the mining plan is based on 1,333 tpd from the mechanized cut and fill section (Block B) and 1,167 tpd from the blasthole stoping sections (Block A and C). Block A or Block C, or both may be mined simultaneously.

2.4.2 BLOCK B MECHANIZED CUT AND FILL

An average Mechanized Cut and Fill (MCF) stope block will have a strike length of 310 meters, a width of 11 meters and a height of 100 meters. This has been illustrated on Figure 3-1. Pillars 16 m by 11 m will be left in the middle of each stope block to facilitate future access through the mining zone.

Mining will progress upwards with access to each lift provided from a series of ramps developed from the 9th, 7th and 5th main levels, and from sub level hanging wall drifts.

During mining, the stope block will be initially supported by cable bolts, 13 m long installed on a 1.6 m x 1.6 m pattern from the 9th Level. Additional rock bolts will be installed for local support during mining.

The stoping sequence for any MCF stope will consist of horizontal breasting, blasting, mucking and filling.

The horizontal breasting will be drilled 11 meters wide by 5 meters high using a two boom electric hydraulic jumbo.

2.4.3 BLOCK B MECHANIZED CUT AND FILL (Cont'd)

The broken ore will be mucked using LHD units. These scoop-trams will muck from the stopes to the ore passes situated along the footwall drifts.

The entire stope block will be bolted with grouted cable bolts. In addition, each lift will receive additional support through conventional rock bolting on a 1.2 meter by 1.2 meter grid pattern.

Once a stope lift has been mined it will be filled with hydraulic fill. A cement cap 0.3 m thick tops each lift. Cemented fill will be placed in the void following removal of crown pillars. Each lift will be filled to within 0.5 meter to 1 meter of the roof. The remaining free "space" will provide a horizontal breaking face for the next lift.

2.4.3 BLOCKS A AND C BLASTHOLE STOPE MINING

An average blasthole stope will have a strike length of 80 meters, a width of 11 meters and a vertical height of 100 meters. Each stope block comprises two primary, one secondary and one tertiary stopes as illustrated on Figures 3-4 and 3-5.

The required main level stope development will consist of providing five drawpoints from the hanging wall drift to the footwall ore contact and slot drifts, to facilitate construction of the slot raises.

The other main level and sub-level development consists of crosscuts from the hanging wall drift to an ore fringe drift from which access drifts to slot raises are driven. The next stage is to create a room for drilling by slashing the access drift between the ore contacts.

The stoping sequence in any blasthole stope will consist of blasthole drilling, blasting, drawing, loading and backfilling.

The stope block will be drilled from the main and sub level drill drifts. Holes 110 mm in diameter will be drilled on a square pattern to a depth of 22.4 m where they will break through to the lower level. The direction and orientation of the drill holes will be parallel to the ore body dip. Following the completion of drilling, stope blasting can commence. Explosives will be 90% anfo and 10% water gel.

The broken ore will be mucked from the five footwall drawpoints on the bottom level using LHD units which will transport the ore to footwall ore passes.

After all the broken ore has been removed from a blasthole stope, bulkheads, with provisions for draining, will be built in the drawpoints. Finally, the stope will be filled with hydraulic fill.

2.5 MINE DEVELOPMENT

For purposes of scheduling and budgeting, mine development has been divided into two categories: pre-production development and on-going development both of which are further classified into primary development and stope development. Primary development consists of excavations associated with the infrastructure necessary to allow 2,500 tonnes of ore to be mined per day. This infrastructure consists of the excavations associated with the shaft cross-cut, hanging wall drift, main decline, ore and waste passes, ventilation raises, pumping stations, rail haulage level and crusher station. Figure 2-2 shows a layout of the level development required for the mine.

Stope development consists of excavating the cross-cuts from the hanging wall drift to (and through) the ore zones, slot drifts, drill drifts, stope slashing, and stope raises. The amount of stope development required for average stopes has been illustrated in Figures 3-1, and 3-5 for the MCF abd BHS sections, respectively.

Pre-production development consists of those horizontal, vertical or inclined openings that have been excavated by a contractor prior to full development from the underground mine. This work may originate from the shaft and/or the decline. The costs for completing this work are based on unit costs obtained from mine development contractors. The mine requires a 710 m shaft, 15,672 m of lateral development and 2,898 m of raises before production can start.

On-going development also consists of similar horizontal, vertical or inclined openings. However, this work is to be completed by the mine operator as a part of underground mining. The cost for completing this work has been estimated as a part of the mine operating costs and quantities are developed in Part 3.

Lateral development must be scheduled sufficiently in advance of stoping in order to provide ore outlines, ore reserve grades, stope outlines, ventilation, access for stope drills, etc.

The equipment used to complete this work will consist of two boom electric hydraulic jumbos, diesel powered scooptrams, utility vehicles such as scissor lift trucks, flatbed trucks and powder trucks. All raising will be by Alimak raise equipment or a raise-boring machine.

Except for that portion of lateral development completed during the pre-production phase, all of this work will be completed by the operator. For the purpose of this report the productivities given and developed in Part 4 have been used.

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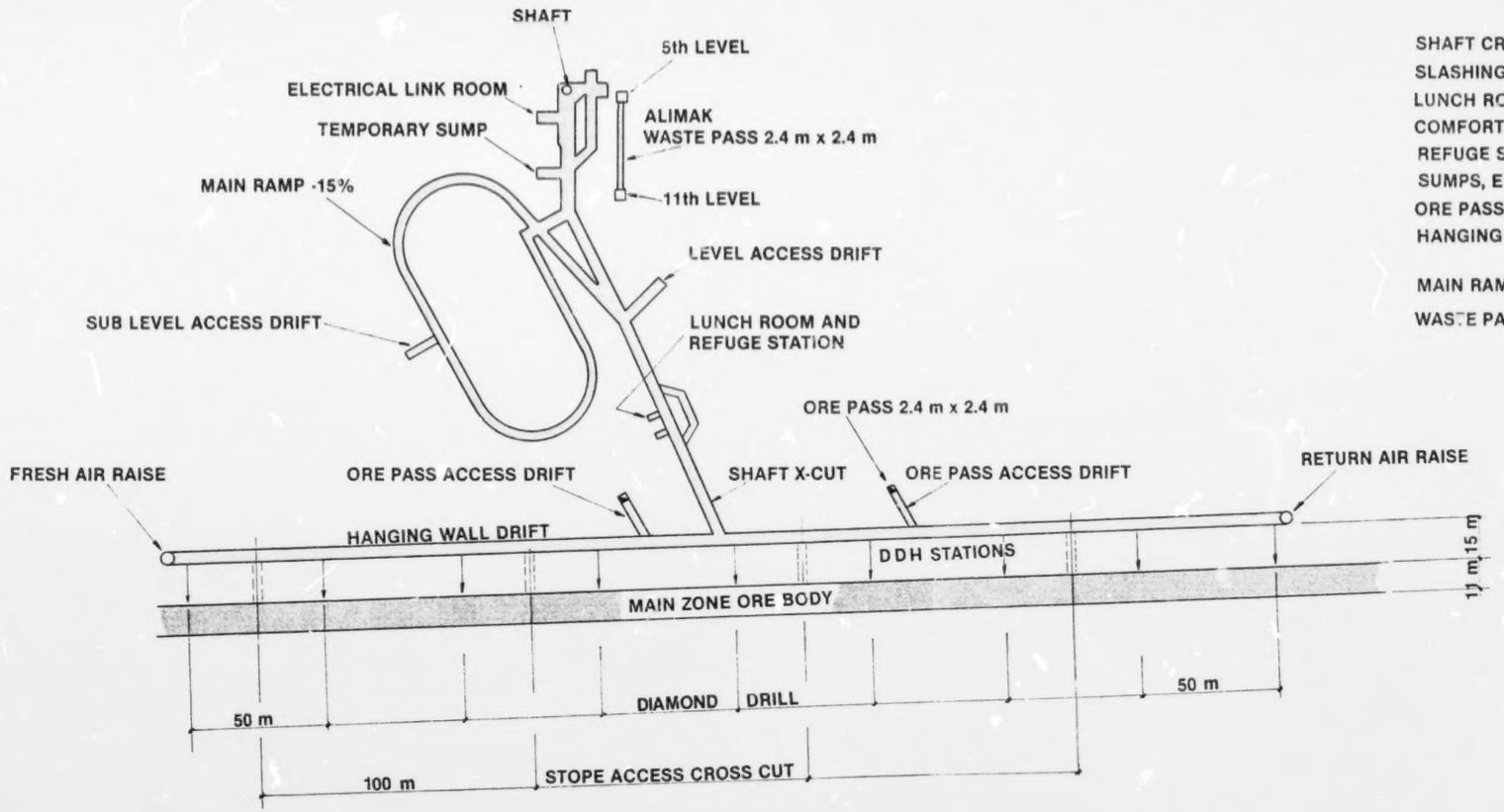

DEVELOPMENT DIMENSIONS

SHAFT CROSS CUT SLASHING LUNCH ROOM COMFORT STATION REFUGE STATION SUMPS, ELECTRICAL STATIONS ORE PASS ACCESS DRIFT HANGING WALL DRIFT	3.4 m x 3.4 m	3021 m

MAIN RAMP 4.3 m x 4.3 m = 1,820 m

WASTE PASS, ORE PASS 2.4 m x 2.4 m = 221 m

FIGURE 2-2

TYPICAL LEVEL AND SUB LEVEL LAYOUT
SHOWING PRE-PRODUCTION AND
ON-GOING MINE DEVELOPMENT

2.6 BACKFILL

In order to recover 100% of the ore reserves, using the stope methods considered above, it will be necessary to backfill all of the stopes and pillars. Investigations were completed by a specialist consultant and the backfill proposals covered in this report are based on his recommendations.

For the purpose of this report it has been assumed that a combination of dry fill and tailings fill will be used. In order to transport the dry fill to the stopes a series of fill raises interconnected to a main raise will be developed from the underground to surface. The main raise will surface in an area adjacent to the ramp portal. At this site a crushing and screening plant will be installed to provide a sized dry fill to the stopes.

Feed for this plant will consist of underground waste rock hoisted to surface and sand from surface pits. Following preparation, the fill will be dumped into the main raise and distributed to stopes or levels via the interconnected fill raises. On some levels it will be necessary to haul the fill with trucks or scooptrams and dump it into the stopes. During the placing of the dry fill, cemented tailings fill will be added to impregnate and consolidate the dry fill.

2.7 EQUIPMENT SELECTION

For the purpose of this report the following major pieces of mining equipment have been considered:

Development Jumbos	- 2 boom electric hydraulic
Development Mucking	- 3.8m^3 diesel scooptrams
Utility Vehicles	- scissor lift for rock bolting
	- flatbed with Hiab hoist for service
	- D4 dozer
	- grader
	- powder trucks
	- roof bolting jumbos
	- lubrication truck
Stope Drilling	- 110 mm Ø ITD
Stope Mucking	- 3.8m^3 diesel scooptrams for stope cleaning
	- blockhole drill

The number of pieces of equipment required was determined from the production, drilling and development schedules produced in the following Sections. It has been assumed that each development crew has one jumbo, one scooptram and one scissor lift truck for bolting and servicing. The total number of pieces of equipment required is presented in Tables 4-4 and 4-5.

2.8 MINE SERVICES

2.8.1 GENERAL

Items covered under the heading of mine services consist of fresh water, compressed air, ventilation, electric power and pumping. These are described briefly below.

2.8.2 FRESH WATER

A pump located at a nearby lake will pump fresh water to a storage tank from which it will be fed to a treatment facility.

A buried pipe line will transport potable water to the headframe/collar house basement. From this point it will feed to the underground mine facilities as well as the office, dry, hoistroom and compressor house.

2.8.3 COMPRESSED AIR

Air compressors which will be installed in the compressor house adjacent to the collar house, will supply the mine at 690 KPa. Equipment, powered by compressed air, will be required in the surface and underground shops, development headings, stopes, and for doors and chutes, etc.

2.8.4 VENTILATION

During the process of developing the underground mine, two ventilation systems will be required. The first will be installed to accommodate pre-production development and the second system will be for production stoping.

The anticipated air volumes required can be determined several ways:

1. Based on rule of thumb per tonne of ore hoisted.
2. Based on the OHSA Regulations for diesel equipment plus supplementary volumes for non-diesel areas.
3. Based on localized demand per working level by year and summing this over the mine.
4. Based on minimum flow velocities for each drift, ramp and raise to control contaminants and maintain oxygen levels at or above OHSA levels.

2.8.4 VENTILATION (Cont'd)

Ventilation air for development headings will be supplied through ventilating ducting connected to the main shaft duct. Fans will be installed at the level take-offs and as required along the drift. Vitiated air will exhaust up the shaft to surface. During the winter months all fresh air will be heated using propane fuelled heaters.

Production ventilation involves the provision of sufficient fresh air for men and operating equipment to supply the necessary oxygen and to reduce dust and gaseous contaminants. Part 3 of this report shows the development of the air requirements for the mine.

Fresh air will be supplied through a Fresh Air Raise (FAR) to be drilled and reamed from surface to the 5th Level. The raise will have a diameter of 3.0 m and will be extended (by raise boring) from the 5th Level to the 11th Level. This leg will also be reamed to 3.0 m diameter. On surface, the fresh air raise will be equipped with low pressure fans and propane fuelled heaters for cold weather operation. This equipment will be housed in a building.

The exhaust air will exit the underground workings through a Return Air Raise (RAR), developed by raise boring to a diameter of 1.8 m in three stages, from the 12th Level to the existing ramp where it will connect to the existing ramp ventilation raise.

2.8.5 ELECTRICAL POWER

A detailed list of underground electrical loads provided by the operator was divided into the following categories:

1. Permanent Loads.
2. Pre-production Development Loads.
3. Provisions for Future Sinking Loads.

In Table 2-2 a summary of all the connected loads have been listed with appropriate demand/diversity factors applied, and shows the estimated maximum peak demand to be approximately 3,000 k.V.A.

At the shaft, the surface power distribution voltage is 4,160 volts and this will be the power supply voltage for the underground workings. The portable or movable mining loads will also be supplied at 4,160 volts from fused loadbreak switches located in the station electrical rooms.

TABLE 2-2

Estimated Peak Electrical Power Demand

Equipment	Rated H.P.	Quantity	Total Connected (Load H.P.)	Demand/ Diversity Factor	Demand H.P.
Mine Dewatering Pumps	150	4 (2 standby)	300	0.8	240
MARS Pump	100	1	100	0.8	80
Pit Dewatering	350	2 (1 standby)	350	0.8	280
Station Service	50	12	600	0.5	300
Maintenance Shops	100	2	200	0.5	100
Underground Crushing & Loading Pocket	350	-	350	0.7	245
Air Compressors*	600	4	2,400	0.75	1,800
Drill Jumbos*	150	3	450	0.5	225
Raise Borers*	300	1	300	0.75	225
Diamond Drills*	30	3	90	0.75	70
Vent Fans	100	3	300	0.8	240
Future Sinking Hoisting & Auxiliaries	250	-	250	0.7	175
			5,690		3,980 H.P.
					= approx. 2,970 k.V.A.

Note: Equipment marked with an asterisk (*) is semi-portable or movable mining equipment. All other equipment is stationary or permanently located.

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2.8.6 PUMPING

The underground mine is to be provided with a system designed to handle a small quantity of natural inflow, and mining activity related water such as used for drilling, dust suppression and backfill.

The total mine water inflow estimated is as follows:

Natural inflow	200 USGPM (12.62 L/s)
Drilling water	75 USGPM (4.73 L/s)
Backfill water	120 USGPM (7.57 L/s)
Potable water	5 USGPM (0.32 L/s)

The underground pumping system will have two pumping stations, one on the 12th Level and one on the 6th Level. Each station will be equipped with two, identical, low speed (1,700 RPM) multistage centrifugal pumps each capable of pumping at rate of 300 IGPM (18.93 L/s). All pump lines will be 150 mm in diameter.

2.9 SURFACE FACILITIES

2.9.1 GENERAL

Access to the underground mine will be via a main production shaft and a ramp decline. Both of these openings will be collared on surface.

The shaft hoisting system will consist of two double-drum hoists - a service hoist for cage and counterweight and a skip hoist for ore and waste, a hoistroom, wire ropes, headframe with collar house and conveyances.

A surface dry and office complex will be constructed adjacent to the headframe collar house. These two buildings will be interconnected with a covered walkway.

A backfill preparation plant will be designed to provide both cemented and un-cemented fill to the underground mine.

Additional surface facilities associated with the underground mine are a core building, a cold storage building and a sewage treatment plant.

A brief description of all of the above facilities can be found in the following sections; they are shown on Figure 2-3.

2.9.2 SHAFT

The shaft will be a five compartment, rectangular, timber shaft. The shaft is to be vertical and has been designed to accommodate hoisting of ore, waste, men, and materials. Service lines are located in the shaft manway. During the production phase the shaft will be an up-cast ventilation opening.

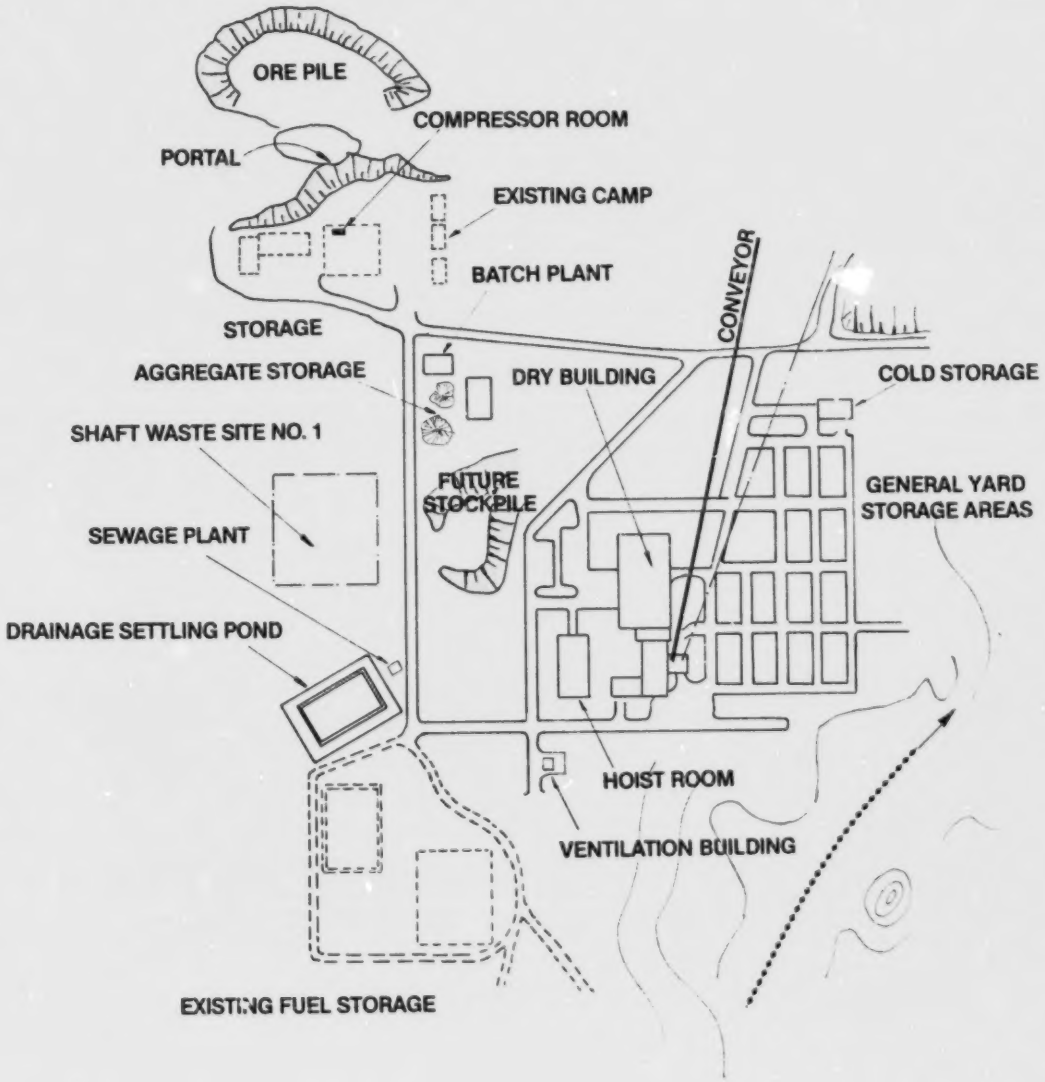

FIGURE 2-3

SURFACE LAYOUT

2.9.2 SHAFT (Cont'd)

In plan, the shaft will measure 4.390 m (north-south) by 6.230 m (east-west) outside the timber sets which measure 242 mm by 242 mm in section located at 2,500 mm intervals. All conveyance guides will measure 196 mm by 146 mm. Compartment dimensions (inside timber) are listed below. Figure 2-4 shows details of the shaft.

Compartment	Dimensions	Guides
Skips (2)	1.832 m x 1.832 m	Karri Wood
Cage	2.210 m x 3.906 m	Douglas Fir
Counterweight	1.220 m x 0.610 m	Douglas Fir
Manway	1.220 m x 3.100 m	

The shaft is to be sunk to a vertical depth of 661.2 m. The first level is 60 m below the collar. There will be 50 m between each level to the 12th Level. Since a certain amount of exploration and pre-production development work will be carried out from the shaft it will be necessary to install lip pockets to accommodate muck removal and hoisting associated with this work.

The 11th Level will be the lowest mining level. The ore reserves to this depth are sufficient to allow underground mining to be carried out for several years at 2,500 tonnes per day. Since the ore is expected to extend below this depth, shaft deepening from the 13th Level may be required in the future.

2.9.3 DECLINE

The decline is to be developed from surface to the 11th Level. It will be 4.5 m wide by 3.3 m high with an inclination of -15% to -20%. Initial underground exploration and bulk sampling will be carried out from this decline.

Lateral development consisting of drifts and cross-cuts will be completed from the ramp. A ventilation raise will be completed from the lowest level to surface.

Future mine development will combine an internal ramp system, used to provide access to the mining sub levels, with the existing decline.

2.9.4 SERVICE HOIST

The service hoist will be a double drum, double clutch hoist. Each drum will have a diameter of 3048 mm, a face width of 1828.8 mm and storage of 1341 m of 38.1 mm diameter rope in three layers. It has been selected to hoist a cage and counterweight in balance.

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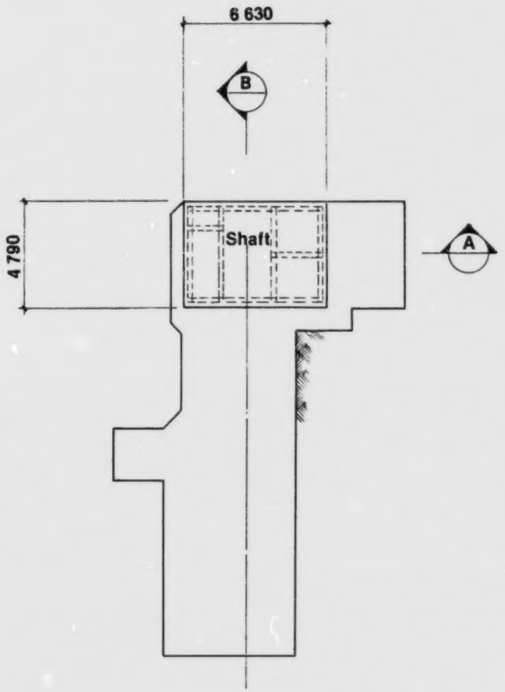
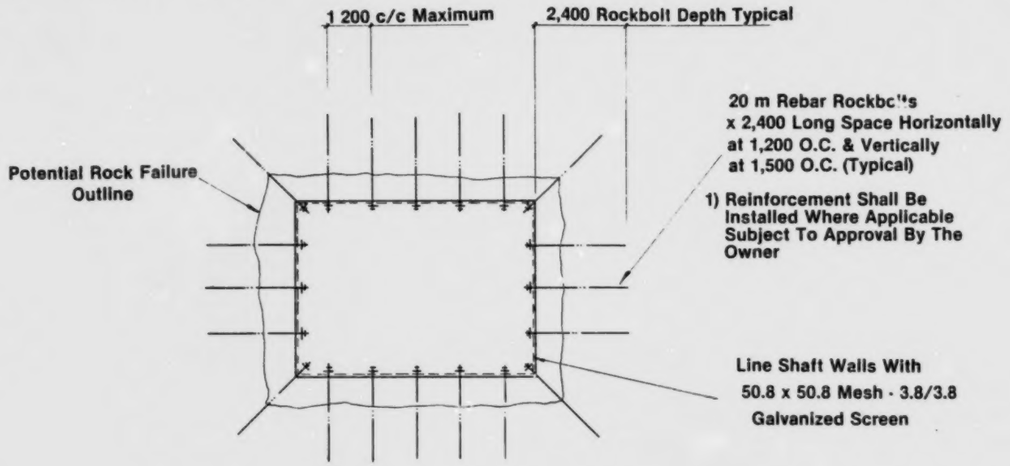
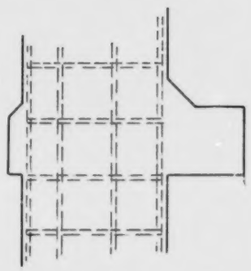


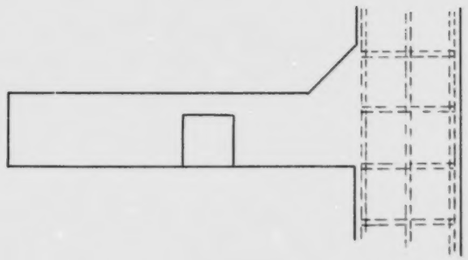
Plans of Typical Station


1 200 c/c Maximum
2,400 Rockbolt Depth Typical
Potential Rock Failure Outline
20 m Rebar Rockbc"s x 2,400 Long Space Horizontally at 1,200 O.C. & Vertically at 1,500 O.C. (Typical)
1) Reinforcement Shall Be Installed Where Applicable Subject To Approval By The Owner
Line Shaft Walls With 50.8 x 50.8 Mesh - 3.8/3.8 Galvanized Screen

Typical Plan Section of Shaft



Section A-A



Section BB

1 5 10m

Scale

Figure 2-4

Plans and Sections of Typical Shaft and Shaft Stations

2.9.4 SERVICE HOIST (Cont'd)

The hoist will be powered by a 480 kw gear coupled D.C. motor with a DC motor generator power supply. The hoisting speed will be 6.1 metres per second.

Using a 38.1 mm diameter rope, the hoist will be capable of hoisting a working load of 9.07 tonnes or a man load of 52 men at the 12th Level with a conveyance weighing 3.86 tonnes.

The service hoist will be available for use by the shaft sinking contractor and during pre-production developement. When used for this duty it will be roped for use in the skip compartments. Once shaft sinking is completed two 5 tonne capacity skip/cage conveyances will be installed and used during the pre-production development program.

2.9.5 SKIP HOIST

The skip hoist will be a new, double-drum, hoist with design criteria as follows:

1. Mine Production:

Ore (to allow for future expansion)	4,000	t/d
Waste	1,600	t/d
Moisture 4%	-	
Total	5,600	t/d

2. Hoisting Distances:

Initial Depth	643	m
Ultimate Depth	947	m

3. Hoisting Hours Per Week:
   14 shifts x 8 hours/day x 80% = 112 hours

2.9.6 HOISTHOUSE

The service hoist and skip hoist will be housed in a metal framed, steel clad, structure. Immediately adjacent to (and part of) the hoisthouse, an annex to house the hoist electrics and electrical distribution switch gear and panels for the mine will be located.

2.9.7 HOISTING ROPES

During shaft sinking the service hoist will be roped with 884 m of 38.1 mm diameter 18 x 7 IWRC shaft sinking ropes. These will be used to hoist two sinking buckets, in balance in the skip compartments.

2.9.7 HOISTING ROPES (Cont'd)

The skip hoist will be roped with 6 x 27 F.C. Flattened Strand Hoisting Rope which will support the skips to the 13th Level loading pockets.

2.9.8 SHAFT CONVEYANCES

During shaft sinking the contractor will use two buckets for mucking. These buckets will travel in a crosshead in the shaft skip compartments.

After the shaft sinking program is completed the pre-production development phase will begin. During this phase two 5 tonne capacity skip/cage conveyances will replace the shaft sinking buckets. These conveyances will be of either a front-dump, moveable body, 9.8 cubic meter (5 tonne) capacity skip with an integral cage or a Sala type conveyance of similar capacity. The conveyance will be manufactured with an all steel bail, aluminum body and steel skip liners and doors.

The permanent conveyances for the service hoist consist of a single deck cage with a man load capacity of 52 men and a materials load capacity of 7,711 kg and a counterweight. Rails will be installed in the floor. A hinged roof hood will permit the handling of 6 m long material inside the cage without slinging. An interior suspension point will permit the handling of 7,711 kg suspended loads. The cage is of aluminum and steel construction.

The cage counterweight will be 7,711 kg. It will consist of a steel frame equal in height to the cage in which removable billets are stacked.

The permanent skips will be a front dump, fixed body type, with a capacity of 5.72 cubic meters (7 tonne). The skips will be either an Arc Door or Sala type construction.

The skips will be loaded through measuring pockets installed below the 12th Level. The measuring boxes will be of steel construction similar in size to the skips. They will measure broken ore and waste on a weight basis only. Operation of the skip hoisting system will be semi-automatic with provision to convert to full automatic.

2.9.9 HEADFRAME, COLLAR HOUSE AND COMPRESSOR BUILDING

The headframe will be a four post, structural steel metal clad structure. The headframe collar house will enclose the headframe tower on three sides and will be connected to the dry/office building. It will serve as a waiting room for personnel entering the cage.

The collar house will enclose a 1,000 tonne capacity ore bin and a 250 tonne capacity waste bin.

The compressor building will be a pre-engineered, structural steel and metal clad. It will be an integral part of the collar house located on the west side of the materials handling area, south of the shaft.

The compressor building will be sized to accommodate four centrifugal type compressors and associated electrical equipment. An air receiver will be located outside, along the north wall of the building. The compressor cooling towers and fans will be located south of the main compressor building and collar house. Only two compressors are to be installed (for a 2,500 tpd operation).

PART 3

QUANTITIES

3.1 MINE DEVELOPMENT

3.1.1 GENERAL

The following development will be carried out as on-going mine development. These quantity take-offs are not shown in detail in this report but reference to Figures 2-1 and 2-2 indicates the locations of each type of heading.

Heading Size

Drift, X-cut or Ramps	Annual Quantity	
3.4 m x 3.4 m	587 m*	*592 m of equivalent
4.3 m x 3.4 m	357 m	3.4 m x 3.4 m heading
3.1 m x 2.7 m	-	
Slash - Eq.m. of 3.4 m x 3.4 m	5 m*	
Total/Year for mine	949 m	

Vertical Development

2.4 m x 2.4 m	
Total/Year for mine	43 m

Operations have been divided into the following categories. Quantities, performance rates and costs have been developed for each operation.

Mine Development
- Drilling
- Blasting
- Pipework
- Ground Support
- Ventilation
- Mucking
- Vertical Development

3.1.2 DRILLING - LATERAL

(b) Number of Holes Per Round

Use following formula:

$$N = 15 + \frac{B \times H - 10\,B \times D - 0.95}{(D \times 17)^2} + \frac{B}{(D \times 12)}$$

where, B is Face width (m)
H is Face height (m)
D is Hole diameter (m)
N is number of holes

3.1.2. DRILLING - LATERAL (Cont'd)

Heading Size	Number of Holes/Round	Holes Loaded
3.4 m x 3.4 m	38	35
4.3 m x 3.4 m	45	42

a) All jumbo drilling will be 44 mm. dia. holes
b) Drilling will be by 2 boom E/H jumbo
c) All holes will be drilled 3.66 m long
d) Each round will break 3.2 m
e) Drilling per year:

(3.4 m x 3.4 m) $\frac{592 \text{ m/year} \times 38 \text{ holes/round} \times 3.66 \text{ m/hole}}{3.2 \text{ m/round broken}}$ = 25,730 m

(4.3 m x 4.3 m) $\frac{357 \text{ m/year} \times 45 \text{ holes/round} \times 3.66 \text{ m/hole}}{3.2 \text{ m/round broken}}$ = 18,374 m

44,104 m

3.1.3 BLASTING - LATERAL

(a) Use 90% nilite and 10% tovex explosives
(b) Use non-electric delay detonators
(c) Assume 3 cut-holes are not loaded
(d) Assume 80% of hole is loaded
(e) The density of loading nilite with air loader is 1.03 g/cc or 1.56 kg/m loaded for 44 mm holes
(f) The density of loading tovex is 1.24 g/cc or 1.88 kg/m loaded for 44 mm holes

Quantities (For on-going mine development during life of mine)

Heading	Development Per Year	Nilite Holes Loaded	Nilite Kg/Rd	Nilite Dev. Kg/m	Tovex 2000 sd Holes Loaded	Tovex 2000 sd Kg/Rd	Tovex 2000 sd Dev. Kg/m	Non-Els Holes Loaded	Non-Els Number/m
3.4m x 3.4m	592	35	144	45.1	35	18	5.9	35	10.9
4.3m x 3.4m	357	42	173	54.1	42	22	7.1	42	13.1

Total Nilite 46,013 kg/yr
Total Toven 6,027 kg/yr
Total Non-Els 11,130/yr

3.1.3 BLASTING LATERAL (Cont'd)

Sample Calculation:

35 holes/round x 3.66 m/hole x 80% filling x 90% nilite x 1.65 kg/m
= 144 kg/round

3.1.4 PIPE WORK - LATERAL

(a) All headings have one 5.1 cm (2") water line and one 15.2 cm (6") air line, 949 m per year

3.1.5 GROUND SUPPORT - LATERAL

(a) 2.4 m long rock bolts on a 1.6 m x 1.6 m drill pattern for 100% of back on all levels

(b) Quantities

Heading	Development/Year (m)	Area of Back (m^2)
3.4m x 3.4m	592	2,013
4.3m x 3.4m	357	1,535
Total		3,548

Total rock bolts = $\frac{3,548}{1.6m \times 1.6m}$ = 1,386

Drilling = 1,386 x 2.4 m = 3,326 m

3.1.6 VENTILATION - LATERAL

(a) Install one 106.7 cm (42") vent ducting line per heading, 949 m/year

3.1.7 MUCKING - LATERAL

(a) All mucking is done with 3.8 m^3 scooptrams

(b) Density for broken rock is 1.9 t/m^3

(c) Payload per bucket is 6.5 t with a bucket fill capacity of 0.9 and a density of 1.9 t/m^3

3.1.8 VERTICAL DEVELOPMENT

Heading Size

2.4 m x 2.4 m

Raising = 43 m/year

3.1.8 VERTICAL DEVELOPMENT (Cont'd)

(a) All rounds are drilled 2.4 m long and break 2.1 m

(b) All mucking done by mine development crew

(c) All holes are drilled 35 mm in dia.

(d) 84% of each hole will be loaded with nilite and 16% of each hole with tovex 2000 S.D.

(e) Calculations: using formula in 3.2.2.2
holes drilled is 32
drilling per year: 1,573 m
blasting agents per year:

Nilite	843 kg
Tovex	273 kg
Non-Els	593 kg

3.2 MECHANIZED CUT AND FILL SECTION

3.2.1 GENERAL

Figure 3-1 shows a general layout of the mechanized cut and fill section of the mine and gives the dimensions of the various development works. Figure 3-2 is a typical section of a cut and fill stope showing the mining sequence in relation to the levels and haulage ramps. Figure 3-3 shows a cross section through a fresh air and service drift. These figures were used to calculate the ore and waste quantities for each piece of work.

Operations have been divided into the following categories. Quantities, performance rates and costs have been developed for each operation.

Stope Development
- Drilling
- Blasting
- Pipework
- Ground Support
- Ventilation
- Mucking
- Vertical Development

3.2.1 GENERAL (Cont'd)

Stope Quantities
Stope Piping
Stope Drilling
Stope Blasting
Stope Mucking
Stope Ground Control
Stope Backfill
Roadbed Maintenance
U/G Jaw Crusher Operation
Stope Conveying
Hoisting Operations
Mine Services
Fuel
Tires
Air Heating
Pumping
Electric Power
Ventilation
Rail Haulage
Ore Pass Operation
Equipment Maintenance
Diamond Drilling

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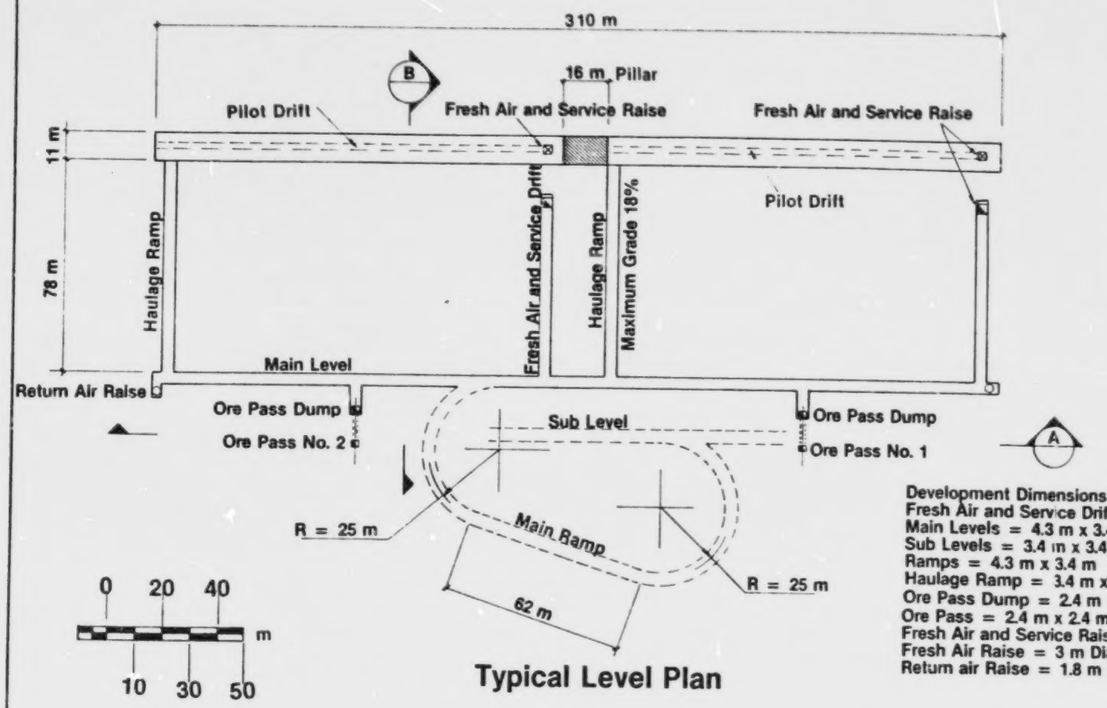
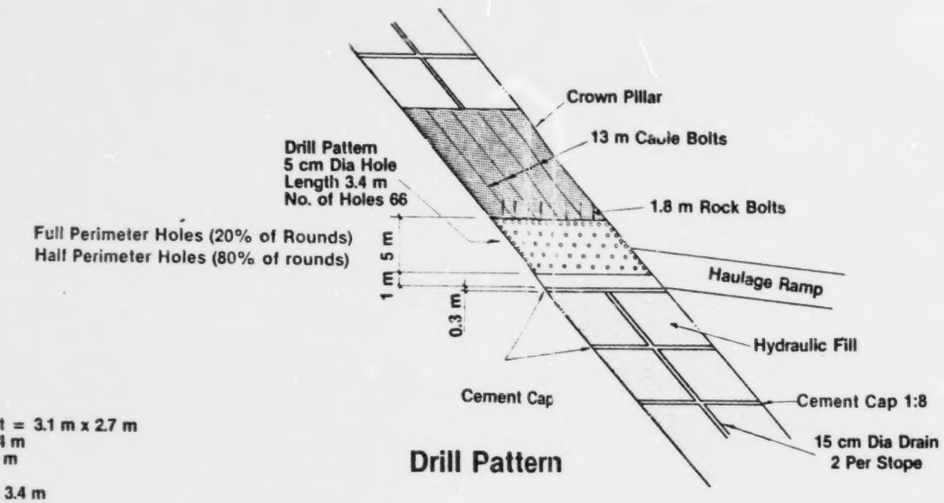


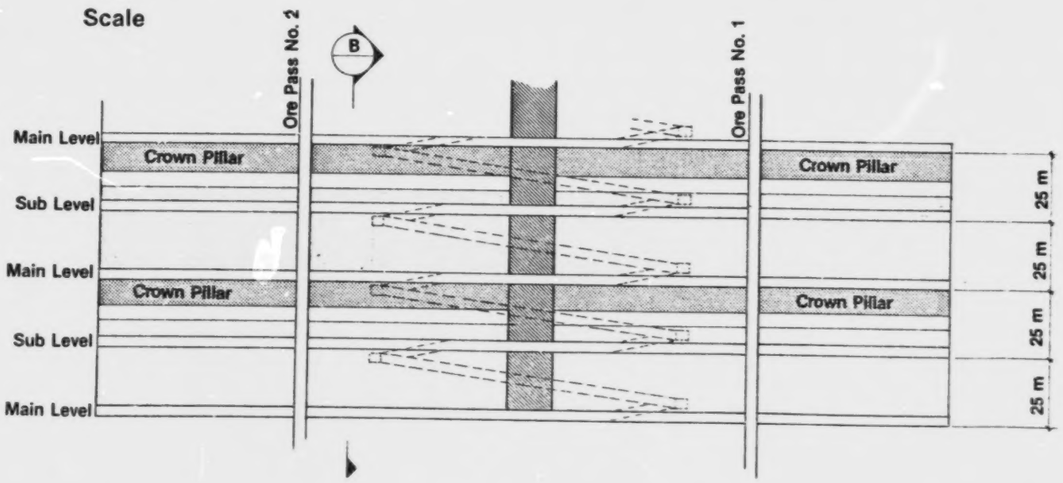
Typical Level Plan

Development Dimensions
Fresh Air and Service Drift = 3.1 m x 2.7 m
Main Levels = 4.3 m x 3.4 m
Sub Levels = 3.4 m x 3.4 m
Ramps = 4.3 m x 3.4 m
Haulage Ramp = 3.4 m x 3.4 m
Ore Pass Dump = 2.4 m x 2.4 m
Ore Pass = 2.4 m x 2.4 m
Fresh Air and Service Raise = 1.5 m x 1.5 m
Fresh Air Raise = 3 m Dia
Return air Raise = 1.8 m Dia

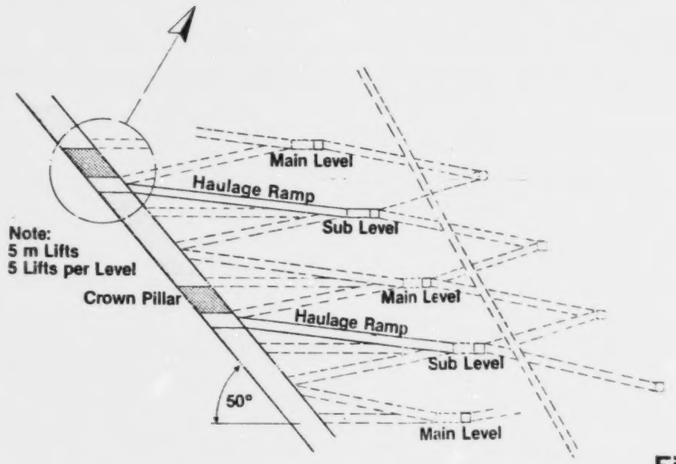


Drill Pattern

Ground Support
Rockbolts: L = 1.8 m 1.6 m x 1.6 m Pattern
Bolts Required Per Slice: 24 Bolts
Cable Bolts: L = 13 m 1.6 m x 1.6 m Pattern
Note: Dimensions of One Round
= 11 m x 5 m x 3.4 m



General Longitudinal Section 'A-A'



Section 'B-B'

Figure 3-1

Mechanized Cut and Fill
General Layout

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NOTE:
Back Slashing is Required to Gain Access to to Each Lift. Each Slash is Equivalent to 60 Metres of 3.4 m x 3.4 m Heading.

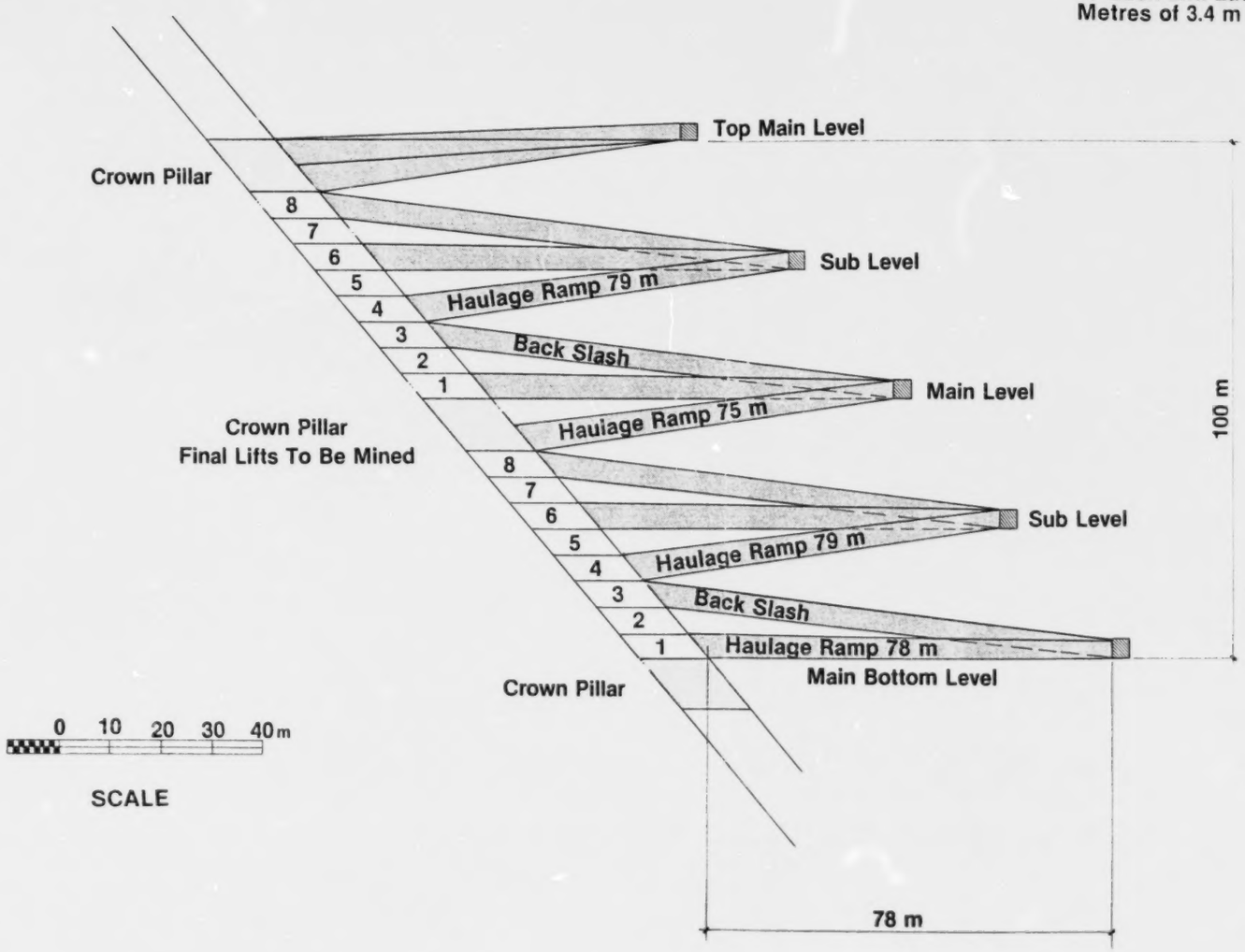

Figure 3-2

Mechanized Cut and Fill
Typical Stope

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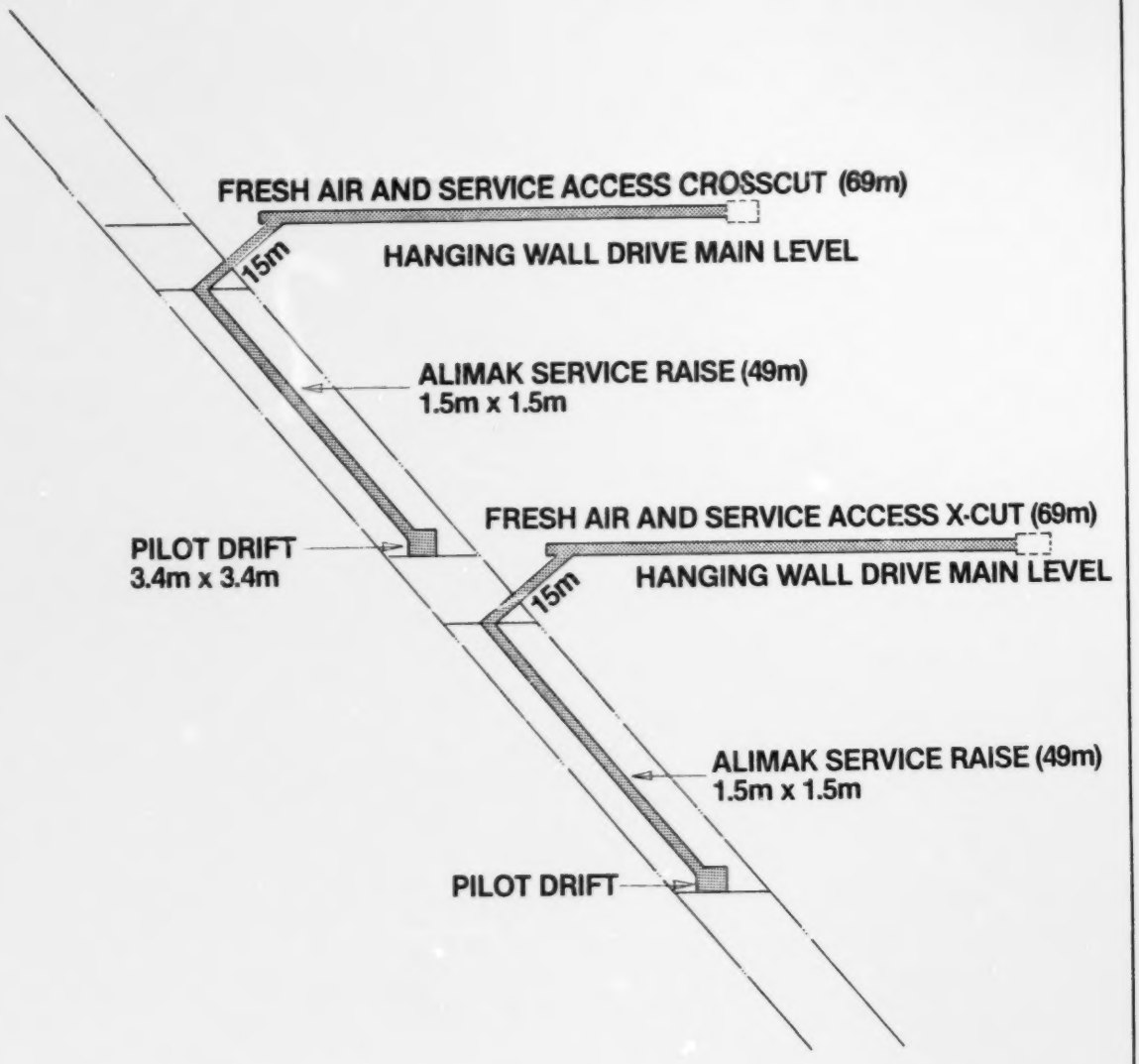
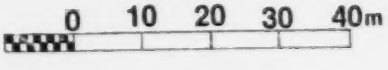




SCALE

FIGURE 3-3

GENERAL CROSS-SECTION THROUGH FRESH AIR AND SERVICE ACCESS CROSSCUT

3.2.2 STOPE QUANTITIES

.1 Ore Tonnage

Length	310 m (less 16 m for pillar)
Width	11 m
Height	100 m
Density	2.9 t/m^3

Quantity of ore is 294 x 11 x 100 x 2.9	937,860 t
Quantity in development works	65,240 t (See 3.2.3)
	872,620 t

Mechanized Cut & Fill Stoping will proceed at the rate of 1,333 tpd or 486,545 t/yr. Therefore, 0.52 stopes required per year.

For simplicity we have assumed that 0.5. stopes will be mined per year and all annual quantities are based on that assumption. We did not, however, nodify the nominal production rate of 1,333 tpd for mechanized cut and fill mining. The annual quantities to be mined by this method are thus assumed to be:

Quantity from stope/year	=	436,310 t or	1,196 t/day
Quantity from development/year	=	32,620 t or	90 t/day
			1,286 t/day

3.2.3 STOPE DEVELOPMENT

.1 Lateral Development (See Figures 3-1, 3-2)

All horizontal development is converted to equivalent lengths of 3.4 m x 3.4 m heading.

3.2.3 STOPE DEVELOPMENT (Cont'd)

a) Main Bottom Level

Haulage ramp to lift no. 1	3.4 m x 3.4 m (2 x 78m)	156 m (waste)
Pilot drift	3.4 m x 3.4 m (2 x 155m)	310 m (ore)
Haulage ramp to lift no. 2	$\frac{81 \text{ m} \times 5 \text{ m} \times 3.4 \text{ m}}{3.4 \text{ m} \times 3.4 \text{ m} \times 1 \text{ m}}$ =	120 m (waste)
Haulage ramp to lift no. 3		120 m (waste)
Wall slash on bottom main level	$\frac{2 \times 143.6 \text{ m} \times 7.6 \text{ m} \times 3.4 \text{ m}}{3.4 \text{ m} \times 3.4 \text{ m} \times 1 \text{ m}}$ =	642 m (ore)
Sub Total		396 m (waste) 952 m (ore)

b) Sub Level

Haulage ramp to lift no. 4	158 m (waste)
Haulage ramp to lift no. 5	120 m (waste)
Haulage ramp to lift no. 6	120 m (waste)
Haulage ramp to lift no. 7	120 m (waste)
Haulage ramp to lift no. 8	120 m (waste)
Sub Total	638 m (waste)

c) Main Level

Same as main bottom level	396 m (waste) 952 m (ore)
Fresh air and service access cross-cut $\frac{2 \times 3.1 \text{ m} \times 2.7 \text{ m} \times 69 \text{ m}}{3.4 \text{ m} \times 3.4 \text{ m}}$	100 m (waste)
Sub Total	496 m (waste) 952 m (ore)

d) Sub Level

Same as first sub level	638 m (waste)

e) Main Level (access from this level to mine 2 lifts in crown pillar)

Haulage ramp to first lift	(2 x 75 m)	150 m (waste)
Haulage ramp to second lift	(2 x 60 m)	120 m (waste)
Sub Total		270 m (waste)

f) Top Main Level (same as main level)

Haulage ramp to first lift	(2 x 75 m)	150 m (waste)
Haulage ramp to second lift	(2 x 60 m)	120 m (waste)
Fresh air and services access cross-cut		100 m (waste)
Sub Total		370 m (waste)

3.2.3 STOPE DEVELOPMENT (Cont'd)

g) Summary of Lateral Development

Work Place	Dev. in Ore	Dev. in Waste	Total Dev. (m)	Tonnes in Ore	Tonnes in Waste	Total Tonnes
Main bottom level	952	396	1,348	31,915	13,276	45,191
Sub level	-	638	638	-	21,388	21,388
Main level	952	496	1,448	31,915	16,628	48,543
Sub level	-	638	638	-	21,388	21,388
Main level to crown pillar	-	270	270	-	9,052	9,052
Top main level	-	370	370	-	12,404	12,404
Total	1,904	2,810	4,712	63,830	94,136	157,966

.2 Vertical Development

a) Alimak Service Raise

1.5 m x 1.5 m raise	2 x 49 m	98 m (ore)
1.5 m x 1.5 m raise	2 x 5 m	10 m (ore)
1.5 m x 1.5 m raise	2 x 9 m	18 m (waste)
		126 m

b) Total Summary of Vertical Development

Vertical Development (2 raises per stope block)

Dev. in Ore	Dev. in Waste	Total Dev.(m)	Tonnes in Ore	Tonnes in Waste	Total Tonnes
216	36	252	1,410	235	1,645

.3 Drilling

(a) Assumptions:

All jumbo drilling will be 44 mm dia. holes
Drilling will be by 2 boom E/H jumbo
All holes will be drilled 3.66 m long
Each round will break 3.2 m

(b) Number of Holes Per Round is 38
See 3.2.1

3.2.3 STOPE DEVELOPMENT (Cont'd)

(c) Drilling per meter of advance

Length of holes drilled = 3.66 m
Length of round blasted = 3.2 m

Meters drilled/m advance = $\frac{38 \text{ holes} \times 3.66 \text{ m long}}{3.2 \text{ m}}$ = 43.5 m/m

Total Drilling/Stope Block = 43.5 m/m x 4,712 m = 20[illegible],972 m
Total Drilling/0.5 stope blocks = 102,486 m/year

.4 Blasting

(a) Assumptions

Use 90% nilite and 10% tovex explosives for supplies
Use non-electric delay detonators
Assume 3 cut-holes are not loaded
Assume 80% of hole is loaded
The density of loading nilite with air loader is 1.03 g/cc or 1.56 kg for 44 mm holes
The density of loading tovex is 1.24 g/cc or 1.88 kg/m for 44 mm holes

(b) Quantities

Horizontal Load Per Hole for all Headings

Nilite: 3.66 x 90% m x 1.56 kg/m x 80% = 4.12 kg
Tovex 2000 SD: 3.66 m x 10% x 1.18 kg/m x 80% = 0.54 kg

Load Per Round

Nilite: 35 holes/rd x 4.12 kg/hole = 145 kg
Tovex 2000 SD: 35 holes/rd x 0.54 kg/hole = 19 kg

Total powder/round 164 kg

Total non-els per round = 35

Total meters of development in .5 stope block = 2,356 m
or 737 rounds/year

Material	kg/Rd	No. of Rds	Total weight/year
Nilite	145	737	106,865
Tovex	19	737	14,003
Non-Els	35	737	25,795

3.2.3 STOPE DEVELOPMENT (Cont'd)

Vertical Load Per Hole (See 3.2.4.9)

Nilite: 2 m x 0.71 kg/m	=	1.42 kg
Tovex 2,000 SD: 0.4 m x .99 kg/m	=	0.40 kg

Load per Round:

Nilite: 18 holes x 1.42 kg/hole	=	26 kg
Tovex: 18 holes x 0.40 kg/hole	=	8 kg
Non-Els: 1/hole x 18 holes	=	18

Since there are 252 meters to develop and the advance is 2.1 meters per round - number of rounds is 120 or 60 rounds/year

Material	Kg/Round	No. Rounds	Total/Year
Nilite	26	60	1,560 kg
Tovex	8	60	480 kg
Non-Els	18	60	1,080 kg

Add 10% for miscellaneous

.5 Development Pipe

(a) One-half of all headings have one 5.1 cm (2") water line and one 15.2 cm (6") air line.

Pipe required per year = $\frac{4,712 \text{ m}}{2 \times 2}$ = 1,178 m

.6 Ground Support

(a) Install 2.4 m rock bolts on a 1.6 m x 1.6 m drill pattern for 100% of back on all levels.

No. required per year = $\frac{3.4 \text{ m} \times 4,712 \text{ m}}{1.6 \text{ m} \times 1.6 \text{ m} \times 2}$ = 3,129 bolts

Length required = 3,129 x 2.4 = 7,510 m/year

.7 Ventilation

(a) Install one 106.7 cm (42") vent ducting in one half of all headings.

Length/year = $\frac{2,356 \text{ m}}{2}$ = 1,178 m/year

3.2.3 STOPE DEVELOPMENT (Cont'd)

.8 Mucking

(a) Mucking is done with $3.8m^3$ scooptrams

(b) Density for broken rock is $1.9\ t/m^3$

(c) Payload per bucket is 6.5 t with a bucket fill capacity of 0.9 and a density of $1.9\ t/m^3$

.9 Stope Vertical Development

(a) All raises are 1.5 m x 1.5 m @ +75°

(b) All rounds are drilled 2.4 m long and break 2.1 m

(c) All holes are drilled 35 mm in dia.

(d) 84% of each hole will be loaded with nilite and 16% of each hole with tovex 2000 S.D.

(e) Calculations:

Drilling: holes/round using formula in 3.1.2 is 21
drilling per year: 1,512 m

blasting agents:	Nilite	1,560 kg
per year	Tovex	480 kg
(see 3.2.3.4)	Non-Els	1,080 kg

3.2.4 STOPE PIPING

Lateral development per stope block = 4,712 m

Since 0.5 stope blocks will be mined per year 2,356 m is required

Pipe is replaceable every second lift therefore 1,178 m of pipe is needed per year

3.2.5 STOPE DRILLING

(a) Assumptions

Drilling equipment is a 2 boom E/H Jumbo
All holes 51 mm in dia.
Drill 3.4 m rounds and break 3.4 m
Full perimeter drilling 20% rounds
Half perimeter drilling 80% rounds

20 lifts per stope block (5 m per lift). Development work in ore is equivalent to 1.4 lifts $\frac{(65,240 \times 20)}{(937,860)}$

3.2.5 STOPE DRILLING (Cont'd)

(b) Quantities

Full Perimeter Drilling (20% of Rounds)

Number of holes = 66
Length of holes = 3.4 m
Meters drilled/round = 224.4 m

One-Half Perimeter Drilling (80% of Rounds)

Number of holes = 49
Length of holes = 3.4 m
Meters drilled/round = 166.6 m

Tonnage/round = 11 m x 5 m x 3.4 m x 2.9 t/m^3
= 542 t

Tonnage/lift = $\frac{872,620 \text{ t/stope block}}{18.6 \text{ lifts/stope block}}$
= 46,915 t

Number of rounds/lift = $\frac{46,915 \text{ t/lift}}{542 \text{ t/round}}$
= 87 rounds/lift

Number of rounds /stope block = 87 rounds/lift x 20 lifts/stope block
= 1,740 rounds/stope block

Number of rounds for 18.6 lifts = 87 rounds/lift x 18.6 lifts for stope drilling
= 1,619 rounds

Stope drilling = 1,619 x 20% x 224.4 + 1,619 x 80% x 166.6
= 72,661 + 215,780
= 288,441 m/stope block or 144,220 m/year

There are 324 rounds (20%) having 66 holes and 1,295 rounds (80%) having 49 holes for one stope block or 162 and 648, respectively per year.

3.2.6 STOPE BLASTING

(a) Assumptions

For 20% of rounds with full perimeter drilling load 34 perimeter holes with trimtex.

For 80% of rounds with one half perimeter drilling load 49 holes. 80% of the hole with 90% nilite and 10% tovex.

All holes 51 mm in diameter.

Density trimtex is 0.57 kg/m, nilite is 2.02 kg/m and of tovex 2000 SD is 1.91 kg/m.

Quantity per hole

Perimeter hole	- Trimtex 1.94 kg/hole	(.57 x 3.4)
Other holes	- Nilite 4.94 kg/hole	(2.02 x 80% x 90% x 3.4)
	- Tovex 0.52 kg/hole	(1.91 x 80% x 10% x 3.4)

(b) Quantity of explosives per round

Full Perimeter Drilling Round

Material	Holes	kg/holes	kg/round
Trimtex	34	1.94	65.96
Nilite	32	4.94	158.08
Tovex	32	0.52	16.64

Half Perimeter Drilling

Material	Holes	kg/holes	kg/round
Nilite	49	4.94	242.06
Tovex	49	0.52	25.48

(c) Summary for Full Perimeter Drilling Round

Material	kg/rd	Non-Els/Rd	No. of Rds	Total kg	Total Non -Els
Trimtex	66		324	21,384	
Nilite	158		324	51,192	
Tovex	17		324	5,508	
Non-Els		66	324		21,384
Sub Total	350	66	324	78,084	21,384

Plus 10% for miscellaneous items
Half these quantities are used annually.

3.2.6 STOPE BLASTING (Cont'd)

(d) Summary for Half Perimeter Drilling Round

Material	kg/rd	Non-Els/Rd	No. of Rds	Total kg	Total Non-Els
Nilite	242		1,295	313,390	
Tovex	26		1,295	33,670	
Non/Els	___	49	1,295	_____	63,455
Sub Total	268	49	1,295	347,060	63,455

Plus 10% for miscellaneous items

Half these quantities are used annually.

(e) Total Explosives

	from (c)	from (d)	Total	Total incl. 10% allowance	Annual Total (½ stope)
Trimtex	21,384	-	21,384	23,522	11,761
Nilite	51,192	313,390	364,582	401,040	200,520
Toven	5,508	33,670	39,178	43,094	21,547
Non-Els	21,304	63,455	84,839	93,322	46,661

3.2.7 STOPE MUCKING

(a) Mucking equipment - 3.8 m^3 LHD equipment
(b) Payload per bucket is 6.5 t per bucket at a bucket fill factor of 0.9 and 1.9 t/m^3 broken rock density
(c) 60% availability for L.H.D. equipment
(d) 1,196 t mined per day (see 3.2.2)
(e) Scooptrams can travel between levels

3.2.8 STOPE GROUND CONTROL

.1 Rockbolts

(a) All rock bolts drilled on a drill pattern of 1.8 m x 1.8 m for 100% of back for all headings
(b) Rock bolts are drilled on a 1.8 m x 1.8 m drill pattern for 25% of the hanging wall
(c) Rock bolts 1.8 m in length

Number of rock bolts per round for back: $\frac{11\text{ m} \times 3.4\text{ m}}{1.8\text{ m} \times 1.8\text{ m}}$

= 12 rock bolts

Number of rock bolts per stope block for 100% of back

12 rock bolts/round x 1,740 rounds/stope block (see 3.2.5) = 20,880

3.2.8 STOPE GROUND CONTROL (Cont'd)

Number of rock bolts in hanging wall:

$$\frac{294 \text{ m long} \times 100 \text{ m high}}{1.8 \text{ m} \times 1.8 \text{ m}} \times 25\% = 2,269$$

Total rock bolts per stope block = 23,149 or 11,575 per year

Drilling 11,575 x 1.8 m = 20,835m/year

.2 Cable Bolts

(a) Cable bolts drilled on 1.8 m x 1.8 m pattern installed every 2nd lift.

(b) Cable bolts 13 m long.

Number of cable bolts per round: $\frac{11 \text{ m} \times 3.4 \text{ m}}{1.8 \text{ m} \times 1.8 \text{ m}}$

= 12 cable bolts

Number of cable bolts per stope block:

$$\frac{12 \text{ cable bolts per round} \times 1,740 \text{ rounds/stope block}}{\text{installed every 2 lifts}} = 10,440$$

or 5,220/year

Drilling:

13 meters/cable bolt x 10,440 cable bolts = 135,720 m

or 67,870 m/year

.3 Screen

(a) Screen installed on 10% of the hanging wall.

Screen/lift = 294 m long x 100 m high x 10% = 2,940 m^2

1 roll is 28 m^2

Therefore, number of rolls is $\frac{2,940}{28}$ = 105/stope block

or 53 rolls/year

3.2.9 STOPE BACKFILL

(a) Assumptions

460 m^3 of backfill per day to replace 460 m^3 of mined ore per day (1,333 tonnes) required

8 timbered bulkheads are required per stope block or 4 for 0.5 stope blocks, or 4 per year

3.2.9 STOPE BACKFILL (Cont'd)

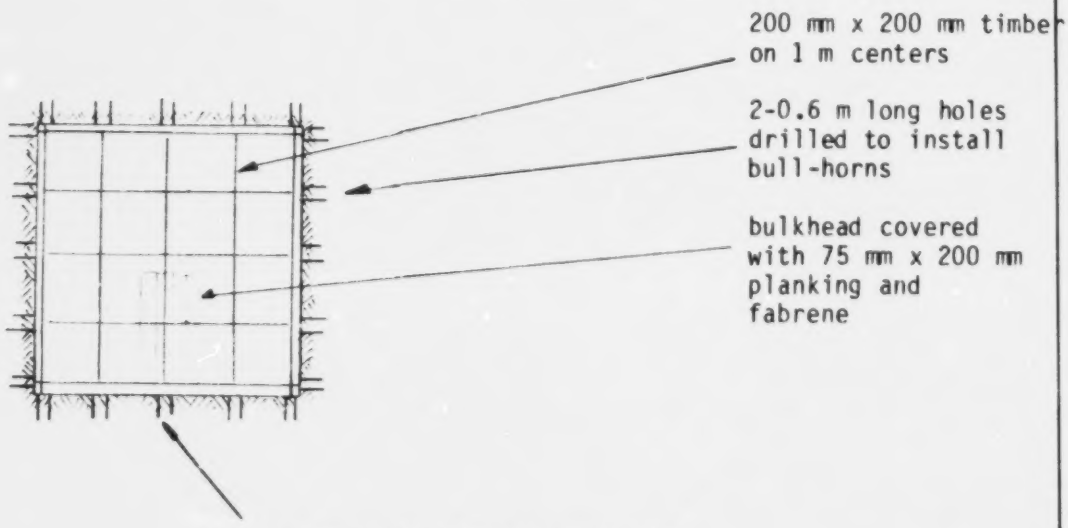
2-150 mm dia. schedule 40 drain pipes used internally per stope block
No bulkheads within stope block

Assume borehole pipe delivers backfill to level

Fill ratios:

cement cap:	1 cement to 8 backfill by weight
cemented hydraulic fill:	1 cement to 12 backfill by weight for crown pillar

The figure belows shows a detail of a standard timber bulkhead from which quantities are derived.


200 mm x 200 mm timber on 1 m centers
2-0.6 m long holes drilled to install bull-horns
bulkhead covered with 75 mm x 200 mm planking and fabrene
0.6 m long holes drilled in floor and timber pinned with #7 rebar

Quantities developed for one bulkhead, times 4 for annual requirements

Timber (Imperial measure is still used for timber)

Vertical Fence Timber (8" x 8") @ 1 m centers (200 mm x 200 mm)

No. of pieces = 5

Horizontal Fence Timber (8" x 8") @ 200 mm centers (200 mm x 200 mm)

No. of pieces = 5

Planking (3" x 8") @ 8" @ 200 mm centers (75 mm x 200 mm)

No. of pieces = 17

3.2.9 STOPE BACKFILL (Cont'd)

8" x 8" Timber

8" x 8" x 16 ft long ÷ 12 = 85.3 Board feet

No. of 8" x 8" timber = 10

Total = 853 Board feet

8" x 3" Timber

3" x 8" x 16 ft long-: 12 = 32 Board feet

No. of 3" x 8" timber = 17

Total = 544 Board feet

Total timber per bulkhead: 853 + 544 = 1,397 Board feet

Allow 80 FBM for wedges
Total timber required = 1,477 Board feet
or 1,477 x 4 = 5,908 Board feet/year

Rebar

Rebar used to pin timber on floor assume 2 rebar per timber each hole drilled 0.6 m long

No. of holes to drill = 10 or 40 per year
Total meters drilled: 0.6 m/hole x 10 holes = 6 m or 24 m per year

Bullhorns 15 No. required or 60 per year
30 holes drilled @ 0.6 m each = 18 m or 72 m per year

Burlap $3m^2$ or $12m^2$ per year

Fabrene (3.4m x 3.4m) $11.56m^2$ or $46m^2$ per year

Cement in Caps

Volume in 1 lift: 294 m x 11 m x 0.3 m
= $970.2\ m^3$

Volume in 20 lifts: $970.2\ m^3$ x 20
= $19,404\ m^3$

Assume in place density is $1.6\ t/m^3$

Tonnage = $1.6\ t/m^3 \times 19,404\ m^3$ = 31,047 t per stope block

Ratio of cement to dry backfill is 1:8
Therefore weight of cement = $\frac{31,047}{9}$ = 3,450 t per stope block
or 1,725 t per year

3.2.9 STOPE BACKFILL (Cont'd)

Cement in Backfill for 5m High Crown Pillar

$\frac{294\ m \times 11\ m \times 5\ m \times 1.6\ t/m^3}{13\ (ratio\ 12:1)}$ = 1,990 t
or 995 t per year

Backfill Pipe (150 mm dia.)

Drain pipe in stope	= 424 m
Fill pipe in stope	= 264 m
Fill pipe in fresh air access cross-cut	= 276 m
Drain line on bottom level	320 m
Total pipe per stope block	1,284 m or 642 m per year

Backfill Material

1,286 t mined per day:

This is equivalent to: $\frac{1,286\ t}{2.9\ t/m^3}$ = 449 m^3

The density of dry hydraulic backfill is 1.6 t/m^3

Therefore the total weight of dry hydraulic backfill required per day is:

449 m^3 x 1.6 t/m^3 = 710 t/day
= 259,150 t/year

3.2.11 ROAD BED PREPARATION AND MAINTENANCE

Mine Development Allow 0.15 m stone bedding

Heading	Size Heading	Dev. (m) (per year)	Vol. Stone (m^3)
Drift & X-Cuts	3.4 m x 3.4 m	587	299
Ramp	4.3 m x 3.4 m	357	182
Slashing		5	3
Total		949 m	484 m^3

Assume that the density of crushed stone is 1.9 t/m^3.
Therefore, quantity of stone is:

484 m^3 x 1.9 t/m^3 = 920 t

Allow 10% for replacement

3.2.11 U/G CRUSHER

Apply half of annual crusher costs to each of Mechanized Cut and Fill and Blasthole Stope operations.

3.2.12 STOPE CONVEYING

(a) The main conveyor on the 13th level is 106.7 cm wide and 50.2 meters long. This is the only belt in operation underground.
(b) Quantity/year - 2,500 t/day x 365 days = 912,500 t.
(c) There will be two 1.2 m wide vibrating feeders feeding from the ore bin onto the conveyor belt and one 1.2 m wide vibrating feeder feeding from the waste pass onto the conveyor belt.
(d) Assume that ½ the total daily requirment of men and equipment will be assigned to each of mechanized cut and fill stopes and blasthole stopes.

3.2.13 HOISTING OPERATIONS

(a) There will be two drum hoists. One hoist with cage and counterweight and the other with skips in balance.
(b) Skip hoist is a 12' x 56" double drum hoist. Each drum will hold 890 meters of 44.4 mm diameter rope, preformed, IPS 6 x 27 flattened strand, fibre core; right langs lay; B.S. - 1361 kN; weight - 7.99 kg/m.
(c) Cage hoist is a 10' x 72" double drum hoist. Each drum will hold 890 meters of 38.1 mm preformed, IPS 6 x 27 flattened strand, fibre core; right langs lay; B.S. - 1001 kN; weight - 5.88 kg/m.
(d) The skips will be arc door type @ 11 t capacity - 5.7m^3; steel construction, medium duty; 8,391 kg, will run on Kerri Wood guides.
(e) The cage will be a single deck; weight 5,897 kg, aluminum/steel construction.
(f) All rock crushed to minus 152 mm for hoisting.
(g) Replace 2 - guides/month in each compartment.
(h) Assume that ½ the total daily requirement of men and equipment will be assigned to each of mechanized cut and fill stope and blasthole stopes.

3.2.14 MINE SERVICES

(a) Level Maintenance and Cleanup

(b) Small Tools

(c) Safety/Mine Rescue Supplies

(d) Cap Lamps

(e) Utility Vehicle

Utility vehicle operates 7 hours/day.

(f) Flatbed Trucks

All trucks operate 7 hours/day

(g) Dozer

Dozer operates 7 hours/day

(h) Lube & Service Truck

Truck operates 7 hours/day

(i) Scissor-Lift Truck

Truck operates 7 hours/day

(j) ½ the total daily requirement of men and equipment will be assigned to each of mechanized cut and fill and blasthole stopes.

3.2.15 FUEL

Equipment (See Table 4-4)	Fuel Consump. Gal/Hour	Average Hours/Day	Units	Fuel Consump./Day
2 Boom Jumbos	1.9	3.0	2.0	11.4
3.8 m^3 Scooptrams	7.1	17.0	3.0	362.1
Flatbed Trucks	3.0	7.0	2.0	42.0
Roof Bolting Jumbo	3.0	7.0	1.0	21.0
Scissor Lift Trucks	3.0	7.0	2.0	42.0
Grader	2.3	7.0	0.5	8.1
Utility Vehicle	3.0	7.0	0.5	10.5
D4 Dozer	3.0	7.0	0.5	10.5
Lube & Service Vehicle	3.0	7.0	0.5	10.5
1.8 m^3 loader	2.0	7.0	0.5	7.0
Anfo Powder Trucks	3.5	7.0	2.5	61.3
Total			15.0	586.4
Equivalent litres				2220 L
	Allow 15% for lubricants		=	2553 L

3.2.16 TIRES

Equipment (See Table 4-4)	Average Hours/Day/Unit	No. of Units
2 Boom Jumbos	3	2.0
3.8 m^3 Scooptrams	17	3.0
Flatbed Trucks	7	2.0
Roof Bolting Jumbo	7	1.0
Scissor Lift Trucks	7	2.0
Grader	7	0.5
Utility Vehicle	7	0.5
Lube & Service Truck	7	0.5
1.8 m^3 Loader	7	0.5
Powder Trucks	7	2.5

3.2.17 AIR HEATING

.1 Air Requirements

Mechanized Cut & Fill Section

Assumptions

a) 125 c.f.m. per B.H.P.

b) 20% for leakage

Equipment (See Table 4-4)	HP/Unit	No. of Operating Units	CFM Required @ 125 C.F.M./B.H.P.
2 Boom Jumbos	52	2.0	13,000
3.8 m^3 Scooptrams	185	3.0	69,375
Flatbed Trucks	76	2.0	19,000
Roof Bolting Jumbo	57	1.0	7,125
Scissor Lift Trucks	76	2.0	19,000
Grader	125	0.5	7,813
Utility Vehicle	53	0.5	3,313
D4 Dozer	80	0.5	5,000
Lube & Service Vehicle	76	0.5	4,750
1.8 m^3 Loader	65	0.5	4,063
Powder Trucks	76	2.5	23,750
Total		15.0	176,189
Plus 20% for leakage			35,238
Grand Total			211,427

.2 Heat Requirements

(a) Temperature required 40°F

(b) Heat Exchange Efficiency 80%

(c) Specific Heat of Air is 0.24 Btu/lb°F

(d) Unit weight of Air at 40°F is 0.78 lb/ft^3

3.2.17 AIR HEATING (Cont'd)

.2 Heat Requirements (Cont'd)

(e) Temperatures and Degree Days

Month	Mean Temp°F	F° Heat	Days	Degree Days
January	-1.0	41.0	31	1,271.0
February	3.4	36.6	28	1,024.8
March	14.9	25.1	31	778.1
April	33.1	6.9	30	207.0
May	46.9	-	-	-
June	57.2	-	-	-
July	61.7	-	-	-
August	59.7	-	-	-
September	50.2	-	-	-
October	40.3	-	-	-
November	24.8	15.2	30	456.0
December	-5.7	45.7	31	1,416.7
		Total		5,153.6

Degree hours: 5,153.6 degree days x 24 hours/day = 123,687/yr

Propane required per year is:

$$\text{US gallons/year} = \frac{123{,}687 \text{ degree hours} \times 211{,}427 \text{ ft}^3/\text{min} \times 60 \text{ min/hr} \times .24 \text{ Btu/lb°F} \times 0.078 \text{ lb/ft}^3}{80\% \times 110{,}000 \text{ Btu/gal.}}$$

$$= 333{,}778 \text{ gallons/year}$$

or 1,263,460 litres/year

3.2.18 STOPE PUMPING

(a) Two identical pumps will be selected to pump from the 14th level to surface in two equal stages (330 meters each).
(b) The pump discharge pipe is 152 mm in diameter.
(c) Mine water inflow will be from the following sources:

Backfill	-	120 USGPM	(7.57 L/s)
Drill water	-	75 USGPM	(4.73 L/s)
Ground water	-	200 USGPM	(12.62 L/s)
Potable water	-	5 USGPM	(0.32 L/s)
	Total	400 USGPM	(25.24 L/s)

(d) Settling sumps will be designed and maintained to allow a maximum 1% solids by weight in the mine water to be pumped.
(e) The solid material passing through the pump is greater than 60% silica and less than 0.15 mm in size.
(f) Assume that ¼ of the total daily requirement of men and equipment will be assigned to each of mechanized cut and fill and blasthole stopes.

3.2.19 ELECTRIC POWER

(a) Electric power requirements were considered for the following equipment

Compressors
Skip hoist
Cage hoist
U/G jaw crusher
Battery charging stations
U/G conveyor
Loading pocket
Ventilation fans
Pumps
Raise bore drills
Electrical/hydraulic jumbos
Diamond drills
U/G lighting
Hoist room
Headframe and collar house

3.2.20 VENTILATION

(a) Repairs required to ventilation doors (15) and regulators (7)

(b) Repairs to 16 fans for mine air

(c) Repairs to 21 million B.T.U. heater

3.2.21 RAIL HAULAGE

(a) Use - 7 - 10 tonne O&K cars) one
- 2 - 8 tonne battery locos) train

(b) The train will haul from 4-ore pass chutes only. The train will not pull waste.

(c) Each battery loco will have 3 batteries. Replace 3 sets of 3 batteries every 20 years.

(d) Assume that ½ of the total daily requirement of men and equipment will be assigned to each of mechanized cut and fill and blasthole stopes.

3.2.22 ORE PASS OPERATION

(a) Assume dust doors are installed at every dump (7)

(b) There is reinforced concrete at every dump (7)

(c) This item covers cost of operating and maintaining rock breakers

3.2.23 EQUIPMENT MAINTENANCE

(a) Assume direct labour - 55% of maintenance costs

(b) Assume repair parts - 45% of maintenance costs

3.2.24 DIAMOND DRILLING

(a) 100% AQ drilling

(b) Hole length is 100 meters, 3 holes per station

(c) All D.D.H. stations at 12.5 m centres on all levels. There are 7 stations per level.

(d) Assume 30,000 m of drilling in 1 year for definition drilling for both mining sections.

3.3 BLASTHOLE STOPING SECTION

3.3.1 GENERAL

Figures 3-4 and 3-5 show a general layout of a blasthole stope, together with the dimensions of all development works. The quantities derived in this Section are all taken from that drawing.

Blasthole Stoping Operations have been divided into the following categories. Quantities, performance rates and costs have been prepared for each operation.

Stope Development
- Drilling
- Blasting
- Pipework
- Ground Support
- Ventilation
- Mucking
- Vertical Development

3.3 BLASTHOLE STOPING SECTION (Cont'd)

Stope Quantities
Stope Piping
Stope Drilling
Stope Blasting
Stope Mucking
Stope Secondary Blasting
Stope Ground Control
Stope Back-fill
Roadbed Maintenance
U/G Jaw Crusher Operation
Stope Conveying
Hoisting Operations
Mine Services
Fuel
Tires
Mine Air Heating
Pumping
Electric Power
Ventilation
Rail Haulage
Ore Pass Operation
Equipment Maintenance
Diamond Drilling

Quantities and key criteria affecting costs are addressed in this Section of the report.

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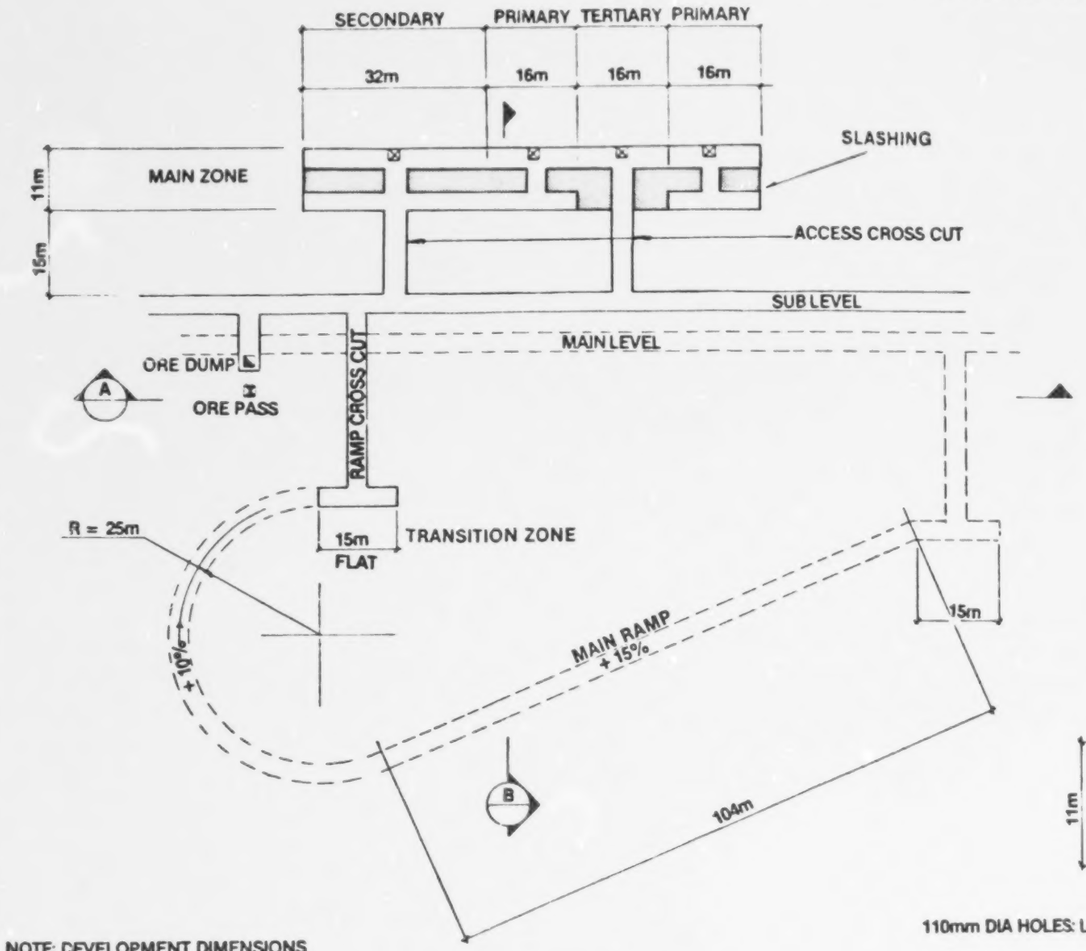


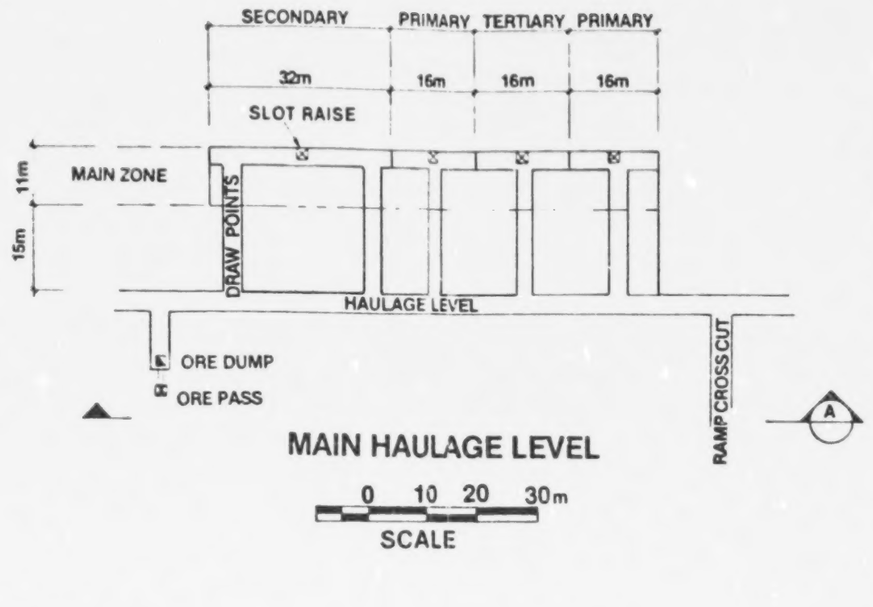
NOTE: DEVELOPMENT DIMENSIONS

MAIN LEVELS:	4.3m x 3.4m
DRAW POINTS:	3.4m x 3.4m
SLOT RAISE:	1.8m x 1.8m
ORE DUMPS:	2.4m x 2.4m
ORE PASS:	2.4m x 2.4m
RAMPS:	4.3m x 3.4m
RAMP CROSS CUTS:	4.3m x 3.4m
ACCESS CROSS CUTS:	3.4m x 3.4m
SLOT DRIFTS:	3.4m x 3.7m
SUB LEVEL DRIFTS:	3.4m x 3.4m

SUB LEVEL PLAN

0 10 20 30m

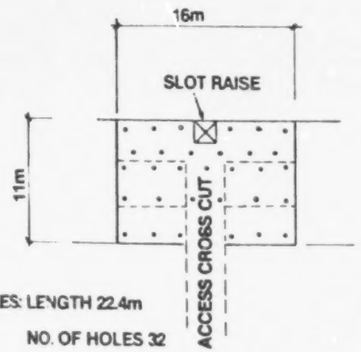
SCALE



MAIN HAULAGE LEVEL

0 10 20 30m

SCALE



110mm DIA HOLES: LENGTH 22.4m

NO. OF HOLES 32

PRIMARY AND TERTIARY LEVELS - DRILL PATTERN

FILL REQUIREMENTS:

PRIMARY: CEMENTED TAILINGS

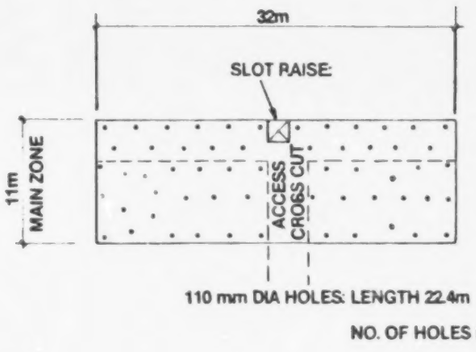
TERTIARY: UNCONSOLIDATED TAILINGS

SECONDARY UNCONSOLIDATED TAILINGS

GROUND SUPPORT

ROCKBOLTS L 2.4m 1.6m x 1.6m PATTERN

CABLEBOLTS L 7.3m 2.4m x 2.4m PATTERN



110 mm DIA HOLES: LENGTH 22.4m

NO. OF HOLES 57

SECONDARY LEVELS - DRILL PATTERN

FIGURE 3-4

BLASTHOLE STOPE
GENERAL LAYOUT

SHEET 1

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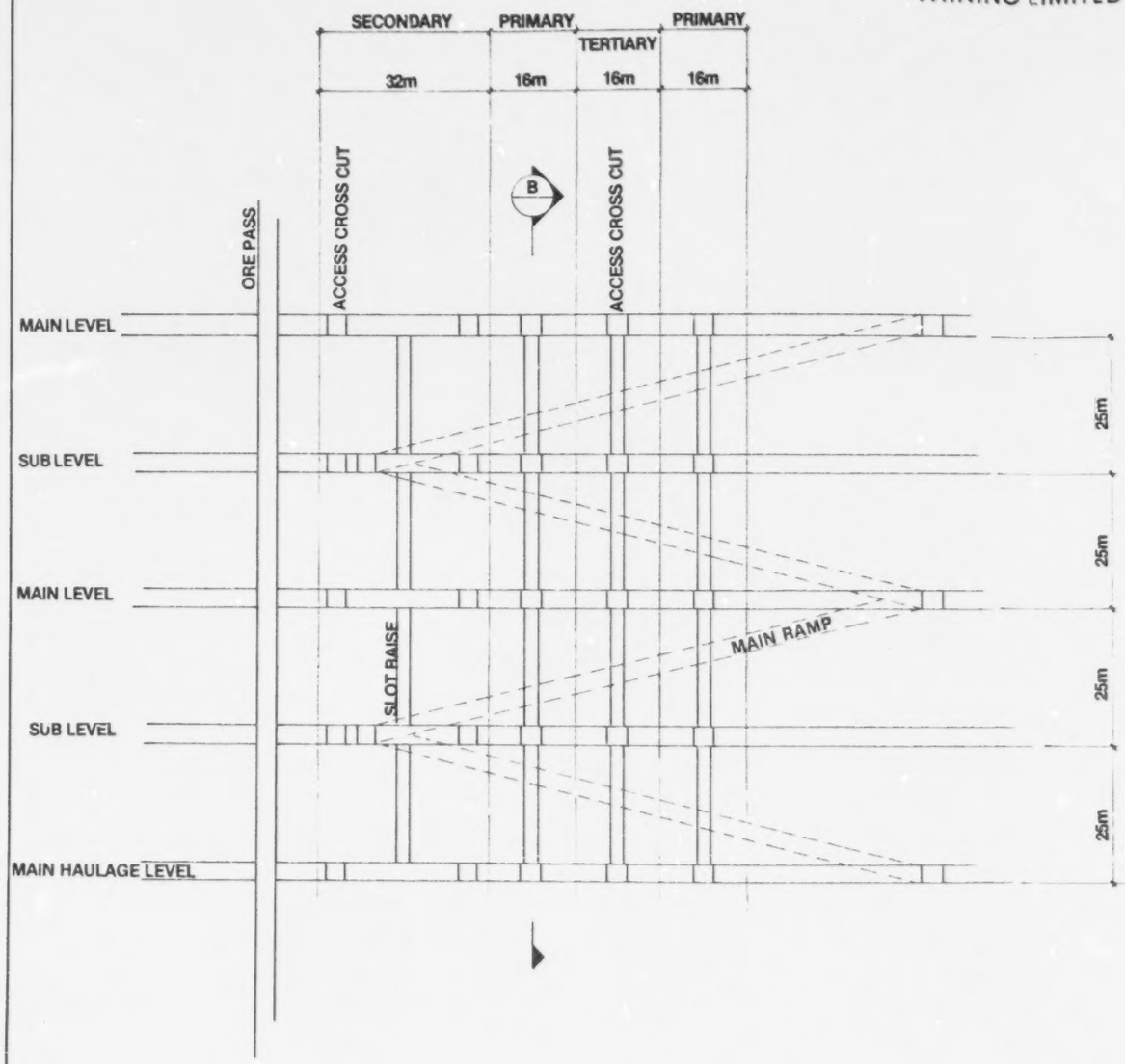
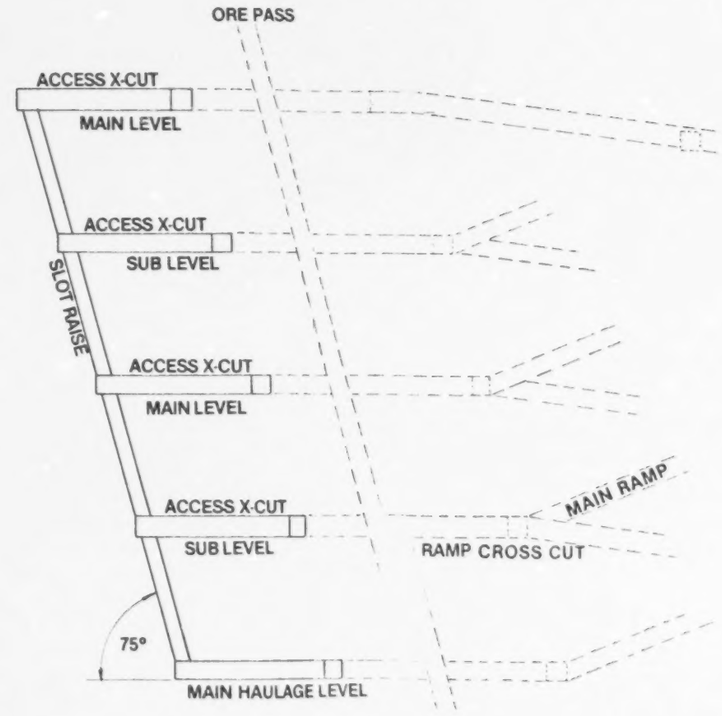


GENERAL LONGITUDINAL SECTION A-A



SECTION B-B

0 10 20 30 40m

SCALE

FIGURE 3-5

BLASTHOLE STOPE
GENERAL LAYOUT

SHEET 2

3.3.2 BLAST HOLE STOPE QUANTITIES

.1 Ore Quantity

Typical Blasthole Stope Block Length - 80 m

Width - 11 m

Height - 100 m

Quantity of ore 80 m x 11 m x 100 m x 2.9 t/m = 255,200 t

Quantity in development works = 32,351 t (see 3.3.3)

222,849 t

Tonnage Per Stope Block to be Blasted by Blasthole Stope Method

First Primary Stope	44,570 t
Second Primary Stope	44,570 t
Secondary Stope	89,139 t
Tertiary Stope	44,570 t
Total	222,849 t

.2 Stope Blocks Per Year

Assume 1,167 t/day for 365 days/year

425,955 t per year from blasthole stopes is required

No. of Stope Blocks Required Per year: $\frac{425,955}{255,200}$

= 1.669, say 1.7 stope blocks

Rounding to 1.7 stope blocks the annual quantities are (see note under 3.2.2)

Lateral development in ore	54,997 t or	151 tpd
Production ore	378,843 t or	1,038 tpd
Total	433,840 t	1,189 tpd

3.3.3 STOPE DEVELOPMENT

.1 First Primary Stope - Lateral Development

.11 Main Haulage Level

		Waste	Ore	Total
Stope drawpoint	3.4 m x 3.4 m	15 m	7.6 m	22.6 m
Undercut	3.4 m x 3.4 m	-	16 m	16 m
Total		15 m	23.6 m	38.6 m

Note: Development is common to two adjacent (vertically) stopes. Therefore there will be 7.5 m waste and 11.8 m ore.

.12 Sub Level

Stope access drift	3.4 m x 3.4 m	-	23.6 m	23.6 m
Slashing to create sill:	$\frac{12.6 \text{ m} \times 7.6 \text{ m} \times 3.4 \text{ m}}{3.4 \text{ m} \times 3.4 \text{ m} \times 1 \text{ m}}$			
		-	28.2 m	28.2 m
Total:		-	51.8 m	51.8 m

.13 Main Level

Because of stope design the second main level will be developed similar to sub level.

Total stope development 51.8 m (ore)

.14 Sub level

Because of stope design the second sub will be developed similar to the first sub level.

Total stope development 51.8 m (ore)

3.3.3 STOPE DEVELOPMENT (Cont'd)

.15 Top Main Level

Development is common to two adjacent (vertically) stopes.
Therefore there will be 25.9 m (ore)

.16 Summary of First Primary Stope Development

Work Place	Heading Size	Dev. in Waste	Dev. in Ore	Total
Haulage level	3.4 m x 3.4 m	7.5 m	11.8 m	19.3 m
Sub level	3.4 m x 3.4 m	-	51.8 m	51.8 m
Main level	3.4 m x 3.4 m	-	51.8 m	51.8 m
Sub level	3.4 m x 3.4 m	-	51.8 m	51.8 m
Top main level	3.4 m x 3.4 m	-	25.9 m	25.9 m
Total lateral development		7.5 m	193.1 m	200.6 m
	say	8 m	193 m	201 m

(a) Total first primary stope development in waste 269 t
(8 m x 3.4 m x 3.4 m x 2.9 t/m3)

(b) Total first primary stope development in ore 6,470 t
(193 x 3.4 m x 3.4 m x 2.9 t/m3)

Length of stope 16 m

Width of stope 11 m

Height of stope 100 m

Total ore per primary stope to be mined by blasthole stope method

16 m x 11 m x 100 m x 2.9 t/m3	51,040 t	
less	6,470 t	in development
	44,570 t	

2. Second Primary Stope - Lateral Development

Exactly the same quantities of lateral development work apply to the second primary stope.

3.3.3 STOPE DEVELOPMENT (Cont'd)

3. Secondary Stope - Lateral Development

.31 Main Haulage Level

		Waste	Ore	Total
Stope drawpoint 1	3.4 m x 3.4 m	15 m	7.6 m	22.6 m
Stope drawpoint 2	3.4 m x 3.4 m	15 m	7.6 m	22.6 m
Undercut	3.4 m x 3.4 m	-	32 m	32 m
Total secondary stope development		30 m	47.2 m	77.2 m

Note: Development is common to two adjacent (vertically) stopes. Therefore, there will be 23.6 m ore and 15 m waste.

.32 Sub Level

Stope acc. drift	3.4 m x 3.4 m	15 m	39.6 m	54.6 m
Slashing to create sill	$\frac{28.6 \text{ m} \times 7.6 \text{ m} \times 3.4 \text{ m}}{3.4 \text{ m} \times 3.4 \text{ m}}$			
	=	-	63.9 m	63.9 m
Total stope development		15 m	103.5 m	118.5 m

.33 Main Level

Because of stope design the second sub level will be developed similar to the first sub level.

Total stope development	15 m	103.5 m	118.5 m

.34 Sub Level

Because of stope design the second sub level will be developed similar to the first sub level.

Total stope development	15 m	103.5 m	118.5 m

.35 Top Main Level

Development is common to two adjacent (vertically) stopes. Therefore, there will be	7.5 m	51.8 m	59.3 m

3.3.3 STOPE DEVELOPMENT (Cont'd)

.36 Summary of Secondary Stope Development

Work Place	Size Heading	Dev. in Waste	Dev. in Ore	Total
Haulage level	3.4 m x 3.4 m	15 m	23.6 m	38.6 m
Sub level	3.4 m x 3.4 m	15 m	103.5 m	118.5 m
Main level	3.4 m x 3.4 m	15 m	103.5 m	118.5 m
Sub level	3.4 m x 3.4 m	15 m	103.5 m	118.5 m
Top main level	3.4 m x 3.4 m	7.5 m	51.8 m	59.3 m
Total lateral development		67.5 m	385.9 m	453.4 m

Total secondary stope development tonnage 15,221 t

(a) Total stope development in ore
(386 m x 3.4 m x 3.4 m x 2.9 t/m3) 12,941 t

(b) Total stope development in waste
(68 m x 3.4 m x 3.4 m x 2.9 t/m3) 2,280 t

Length of stope 32 m

Width of stope 11 m

Height of stope 100 m

Total ore per secondary stope to be mined by blasthole stope method

32 m x 11 m x 100 m x 2.9 t/m3	102,080 t	
less	12,941 t	in development
	89,139 t	

.4 Tertiary Stope - Lateral Development

.41 Main Haulage Level

		Waste	Ore	Total
Stope drawpoint	3.4 m x 3.4 m	15 m	7.6 m	22.6 m
Undercut	3.4 m x 3.4 m	-	16 m	16 m
Total tertiary stope development		15 m	23.6 m	38.6 m

3.3.3 STOPE DEVELOPMENT (Cont'd)

Note: Development is common to two adjacent (vertically) stopes. Therefore, there will be 7.5 m waste and 11.8 m ore.

.42 Sub Level

		Wate	Ore	Total
Stope access drift	3.4 m x 3.4 m	22.6 m	15 m	7.6 m
Slot drift	3.4 m x 3.4 m	16 m	-	16 m
Slashing to create sill: $\frac{12.6\text{ m} \times 7.6\text{ m} \times 3.4\text{ m}}{3.4\text{ m} \times 3.4\text{ m}}$				
		28.2 m		28.2 m
Total stope development		66.8 m	15m	51.8 m

.43 Main Level

Because of stope design the second main level will be developed similar to sub level.

Total stope development	15 m	51.8 m	66.8 m

.44 Sub Level

Because of stope design the second sub level will be developed similar to first sub level.

Total stope development	15 m	51.8 m	66.8 m

.45 Top Main Level

Note: Development is common to two adjacent (vertically) stopes. Therefore, there will be 7.5 m 25.9 m 33.4 m

.47 Summary of Tertiary Stope Development

Work Place	Size Heading	Dev. in Waste	Dev. in Ore	Total
Haulage level	3.4 m x 3.4 m	7.5 m	11.8 m	19.3 m
Sub level	3.4 m x 3.4 m	15 m	51.8 m	66.8 m
Main level	3.4 m x 3.4 m	15 m	51.8 m	66.8 m
Sub level	3.4 m x 3.4 m	15 m	51.8 m	66.8 m
Top main level	3.4 m x 3.4 m	7.5 m	25.9 m	253.1 m
Total stope lateral development		60 m	193.1 m	253.1 m

3.3.3 STOPE DEVELOPMENT (Cont'd)

(a) Total tertiary stope development in waste (60 m x 3.4 m x 3.4 m x 2.9 t/m3) 2,012 t

(b) Total tertiary stope development in ore (193 x 3.4 m x 3.4 m x 2.9 t/m3) 6,470 t

Length of stope	16 m
Width of stope	11 m
Height of stope	100 m

Total ore per tertiary stope to be mined by blasthole stope method
16 x 11 x 100 x 2.9 t/m3 51,040 t
less 6,470 t development
44,570 t

.5 Summary Table of Development for Typical Stope Block

	Meters in Ore	Meters in Waste	Total Meters	Tonnes in Waste	Tonnes in Ore	Total Tonnes
First Primary lateral dev.	193	8	201	269	6,470	6,739
Tertiary lateral dev.	193	60	253	2,012	6,470	8,482
Second Primary lateral dev.	193	8	201	269	6,470	6,739
Secondary lateral devl	386	68	454	2,280	12,941	15,221
Total lateral dev.	965	144	1,109	4,830	32,351	37,181

3.3.4 STOPE DEVELOPMENT DRILLING, BLASTING, PIPE, GROUND SUPPORT, VENTILATION MUCKING AND VERTICAL DEVELOPMENT

Basic criteria and methods for developing quantities under these categories are the same as covered under Section 3.2.3 Subsections .3 to .9, except for pipe and ventilation which are covered below.

Using those procedures annual quantities for 1.7 stope blocks are as follows:

Drilling	82,011 m	Quantities are as those for MCF Section times
*Blasting - Nilite	95,439 kg.	1109m/BHS stope x 1.7 BHS stopes/year
- Tovex	12,748 kg.	4712m/MCF stope x 0.5 MCF stopes/year
- Non-Els	23,656 kg.	
Ground support - Rock Bolts	2503	
- Drilling	6009 m	*Includes allowances for 10% miscellaneous

Pipe work and ventilation ducting are installed for 100% of development headings, i.e. 1,109 m x 1.7 = 1,855 m/year

3.3.5 STOPE DRILLING

.1 Assumptions

(a) All drilling with the "in-the-hole" drill

(b) All holes 110 mm in dia.

(c) All holes drilled 22.4 m long

.2 Slot and Ring Drilling

(a) Primary or Tertiary Stopes

No. of holes drilled per level	32 holes
Length of each hole	22.4 m
Total length drilled per level (primary or tertiary)	716.8 m

(b) Secondary Stopes

No. of holes drilled per level	57 holes
Length of each hole	22.4 m
Total length drilled per level	1,277 m

.3 Slot Drop Raise Drilling for Primary, Secondary and Tertiary Stopes

(a) No. of holes drilled per raise	8 holes
Length of each hole	22.4 m
Total meters drilled per raise	179.2 m
Quantity of ore in slot raises for ore stope: 22.4 m x 4 x 1.8 m x 1.8 m x 2.9 t/m =	842 t

3.3.5 STOPE DRILLING (Cont'd)

.4 Summary of Stope Drilling for Typical Primary or Tertiary Stope Block

Work Place	No. of Holes	Meas. Dist. (m)	Total Meters Drilled
Sub level	32	22.4	717
Main level	32	22.4	717
Sub level	32	22.4	717
Main level	32	22.4	717
Total	128	22.4	2,868

.5 Summary of Stope Drilling for Secondary Stope

Work Place	No. of Holes	Meas. Dist. (m)	Total Meters Drilled
Sub level	57	22.4	1,277
Main level	57	22.4	1,277
Sub level	57	22.4	1,277
Main level	57	22.4	1,277
Total	228	22.4	5,108

.6 Summary of Stope Drop Raise Drilling for Typical Primary, Tertiary or Secondary Stope Blocks

Work Place	No. of Holes	Meas. Dist. (m)	Total Meters Drilled
Sub level	8	22.4	179.2
Main level	8	22.4	179.2
Sub level	8	22.4	179.2
Top main level	8	22.4	179.2
Total	32	22.4	716.8

Summary Table of Drilling in Typical Stope Block

	Slot & Ring m Drilled	t Drilled	t Per m	Drop Raise m Drilled	t Drilled	t Per m	Total Stope	Total m Drilled/Stope
Stope	2,868	43,728	15.25	717	842	1.17	44,570	3,585
First Primary	2,868	43,728	15.25	717	842	1.17	44,470	3,585
Second Primary	5,108	88,297	17.29	717	842	1.17	89,139	5,825
Secondary	2,868	43,728	15.25	717	842	1.17	44,570	3,585
Tertiary	13,712	219,481	16.01	2,868	3,368	1.17	222,849	16,580

Total drilled/year = 16,580 x 1.7
= 28,186 m

3.3.6 STOPE BLASTING

All holes loaded are 110 mm dia.

Powder factor for primary blasting is 0.40 kg/tonne and there are 222,849 t to be blasted per stope block (See 3.3.2)

89,140 kg explosives used per stope block
50% nilite by weight
50% tovex by weight

Product	Quantity	Quantity per Year (1.7 stope blocks)
Nilite	44,570 kg	75,769 kg
Tovex	44,570 kg	75,769 kg
Non-Els	600	1,020
Lead-Line (14 gauge)	3,500 m	5,950 m
E.B. Caps	260	442

Add 10% for miscellaneous

3.3.7 STOPE MUCKING

Assumptions

(a) Mucking equipment - 3.8 m^3 LHD equipment

(b) All haulage on +2% gradient

(c) Payload per bucket is 6.5 t

(d) Mucking requirement of 519 t per shift or 1,038 tpd.

(e) 60% availability for L.H.D. equipment

3.3.8 SECONDARY BLASTING

.1 Assumptions

(a) 2/3 of the ore will be broken by blasting with water gel @ .2 kg/t

3.3.8 SECONDARY BLASTING (Cont'd)

(b) 2/3 all powder in secondary blasting consumed in blasting hang-ups

(c) 1/3 of all powder consumed in blockholing. Use 1.02 kg/m for water gel for holes drilled in rock

(d) Average hang-up blast will require 34 kg of water gel

(e) 1 non-el detonator for 0.6 m of hole drilled

(f) Add 10% for miscellaneous items

.2 Hang-ups @ 0.2 kg/tonne

tonnage: $\frac{2}{3} \times \frac{2}{3} \times 378,843$ (See 3.2.2)

$= 168,375$ t

Explosives required 168,375 t x 0.2 kg/t
= 33,675 kg

Non-Els: $\frac{33,675 \text{ kg}}{34 \text{ kg}} = 991$

.3 Blockholing

tonnage: $\frac{2}{3} \times \frac{1}{3} \times 378,843 = 84,188$ t

Explosives required: 84,188 x 0.2 kg/t = 16,838 kg

Drilling in blockholing:

$\frac{16,838 \text{ kg}}{1.02 \text{ kg/m}} = 16,508$ m

Non Els $\frac{16,508}{0.6} = 27,513$

Allow 10% for miscellaneous

3.3.9 GROUND CONTROL

.1 Assumptions

(a) All rock bolts are 2.4 m long drilled on a 1.6 m by 1.6 m pattern for all levels 100% of back

3.3.9 GROUND CONTROL (Cont'd)

(b) All cable bolts are 7.3 m long drilled on a 2.4 m x 2.4 m pattern for 100% back for all drifts and slashes in ore

(c) These patterns apply to primary, secondary and tertiary stopes

(d) Size of all headings is 3.4 m x 3.4 m

.2 Rock Bolts

Total lateral development required to develop one stope block is 1,109 m.

Number of rock bolts required is $\frac{1{,}109 \text{ m} \times 3.4 \text{ m}}{1.6 \text{ m} \times 1.6 \text{ m}}$ = 1,473 or 2,504/year

Drilling = 1,473 x 2.4 = 3,536 m or 6,011 m/year

.3 Cable Bolts

Total lateral development in ore per stope block is 965 m.

Number of cable bolts required is $\frac{965 \text{ m} \times 3.4 \text{ m}}{2.4 \text{ m} \times 2.4 \text{ m}}$ = 570 or 969/year

Drilling = 969 x 7.3 m/bolt = 7,074 m/year

3.3.10 STOPE BACKFILL

.1 Assumptions

(a) 410 m^3 of fill per day to replace 410 m^3 mined ore (1,189 t) required.

(b) Bulkheads: 17 timbered bulkheads per stope block

(c) Assume one 150 mm schedule 40 pipe per primary, secondary and tertiary stope. There is one pipe in hanging wall drift.

(d) Assume borehole delivers fill to level

(e) Assume 33% hydraulic backfill by weight (at 1.6 t/m^3) and 67% R.O.M. waste rock by weight (at 1.9 t/m^3)

(f) Assume that for 11 m wide ore zones in primary stopes 650 t of cement is required (from results of ground control study).

(g) The dry density of hydraulic backfill is 1.6 t/m^3

3.3.11 STOPE BACKFILL (Cont'd)

(h) Assume life expectancy of schedule 40 pipe is 2,250,000 t (dry weight) of hydraulic backfill

.2 Daily Requirements

1.6 t/m^3 is equivalent to 0.625 m^3/t

1.9 t/m^3 is equivalent to 0.526 m^3/t

For one tonne of fill (H.B.F. & R.O.M. combined)

1/3 x 0.625 m^3/t = 0.208 m^3/t
2/3 x 0.526 m^3/t = 0.351 m^3/t

Overall density is 0.559 m^3/t
= 1.79 t/m^3

Total daily excavation is 410 m^3
= 734 t

Total tonnage of fill required is 410 m^3 x 1.79 t/m^3
= 734 t

Weight of H.B.F. per day = 1/3 x 734 = 245 t/day

Weight of R.O.M. per day = 2/3 x 734 = 489 t/day
Total 734 t/day

.3 Tonnage Required Per Stope Block

Total tonnage of ore mined/stope block
from stope development = 32,351 t
from blasthole hole ore = 222,849 t
Total 255,200 t (See 3.3.2)

Total volume excavated = 255,200 t ÷ 2.9 t/m^3
= 88,000 m^3

Total tonnage of fill required/stope block (HBF & ROM combined)

= 88,000 m^3 x 1.79 t/m^3 = 157,520 t

Weight of H.B.F./stope block = 1/3 x 157,520 = 52,507 t
Weight of R.O.M./stope block = 2/3 x 157,520 = 105,013 t
157,520 t

3.3.10 STOPE BACKFILL (Cont'd)

.4 Cement Content In Stope Block

For 11 m wide ore zone in primary stopes cement requirement is 650 t or 650 x 1.7 t/year = 1,105 t/year

.5 Timbered Bulkheads

Material		
8" x 8" x 16"	Timber	Rebar #7
3" x 8" x 16"	Timber	Bullhorns
Fabrene		Stoper
Weeping Tile		Burlap

Refer to 3.2.9 for quantities of bulkhead materials

1.7 x 17 bulkheads per year are required

Therefore quantities for bulkheads are:

$$\frac{1.7 \times 17 \text{ per year for BHS Section}}{4 \text{ per year for MCF Section}} = 7.225 \text{ times MCF quantities}$$

The quantities required are summarized below:

Timber	42,685 board feet
Rebar	289
Drilling	173 m
Bullhorns	434
Drilling	520 m
Burlap	87 m^2
Fabrene	332 m^2

.6 Backfill Pipe

Schedule 40 150 mm pipe required = 150 m

There are 52,507 t of hydraulic backfill per stope block

The tonnage of hydraulic backfill poured per year in the blasthole stope is:
52,507 x 1.7 stopes per year = 89,262 t

Assuming pipeline has a life of 2,250,000 t of fill before replacement then in 1 year

$$\frac{89,262 \text{ t}}{2,250,000 \text{ t}} = 0.04 \text{ of the pipe will be replaced per year or 6m/year}$$

3.3.11 ROADBED PREPARATION AND MAINTENANCE

See Section 3.2.10 for Mine Development Quantities.

Stope Development for 1.7 Stope Blocks

Bed material 0.15 m thick use in drawpoints only quantity:
1.7 stope blocks x 5 x 15 m x 3.4 m x 0.15 m x 1.9 t/m3 = 125 t

3.3.12 U/G CRUSHER, STOPE CONVEYING, HOSTING OPERATIONS, MINE SERVICES

See Sections 3.2.11 to 3.2.14 for details and quantities.

3.3.14 FUEL

Equipment (Table 4-5)	Fuel Consump. Gal/Hour	Average Hours/Day	Units	Fuel Consump. Gal/Day
2 Boom Jumbos	1.9	3.0	2.0	11.4
3.8 m^3 Scooptrams	7.1	17.0	3.0	362.1
Flatbed Trucks	3.0	7.0	3.0	63.0
Blockhole Drill	2.1	7.0	1.0	14.7
Roof Bolting Jumbo	3.0	7.0	1.0	21.0
Scissor Lift Truck	3.0	7.0	1.0	21.0
Grader	2.3	7.0	0.5	8.1
Utility Vehicle	3.0	7.0	0.5	10.5
D4 Dozer	3.0	7.0	0.5	10.5
Lube & Service Vehicle	3.0	7.0	0.5	10.5
1.8 m Loader	2.0	7.0	0.5	7.0
Powder Trucks	3.5	7.0	1.5	36.8
Total Fuel Consumption/Day				576.6
Equivalent Litres				2,182.6 L

Add 15% to cost of fuel to cover lubricants 2,182.6 L x 1.15 = 2,509 L

3.3.14 TIRES (Table 4-5)

Equipment	Average Hours/Day/Unit	No. of Units
2 Boom Jumbos	3	2.0
3.8 m^3 Scooptrams	17	3.0
Flatbed Trucks	7	3.0
Blockhole Drill	7	1.0
Roof Bolting Jumbo	7	1.0
Scissor Lift Truck	7	1.0
Grader	7	0.5
Utility Vehicle	7	0.5
Lube & Service Truck	7	0.5
1.8 m^3 Loader	7	0.5
Powder Trucks	7	1.5

3.3.15 AIR HEATING

.1 Air Requirements - Blasthole Stoping Section

Assumptions

a) 125 c.f.m. per B.H.P.
b) 20% for leakage

Equipment	HP/Unit	No. of Operating Units	CFM Required @ 125 C.F.M./B.H.P.
2 Boom Jumbo	52	2.0	13,000
3.8 m^3 Scooptrams	185	3	69,375
Flatbed Trucks	76	3	28,500
Blockhole Drill	53	1	6,625
Roof Bolting Jumbo	57	1	7,125
Scissor Lift Truck	76	1	9,500
Grader	125	0.5	7,813
Utility Vehicle	53	0.5	3,313
D4 Dozer	80	0.5	5,000
Lube & Service Vehicle	76	0.5	4,750
1.8 m^3 Loader	65	0.5	4,063
Powder Truck	76	1.5	14,250
Total	1,027	15.0	173,314
Plus 20% for leakage			34,663
Grand Total			207,977 CFM

.2 Heat Requirements

See Section 3.2.17 for temperature and degree-day requirements.

Propane required/year =

$$\frac{123{,}687 \text{ degree hrs/yr} \times 207{,}977 \text{ ft}^3\text{/min} \times 60 \text{ min/hr} \times .24 \text{ Btu/lb°F} \times 0.078 \text{ lb/ft}^3 \times 3.785 \text{ L/gal}}{80\% \times 110{,}000 \text{ Btu/gal}}$$

$$= 1{,}242{,}738 \text{ L/year}$$

3.3.16 PUMPING, ELECTRIC POWER, VENTILATION, RAIL HAULAGE, ORE PASS OPERATION, EQUIPMENT MAINTENANCE AND DIAMOND DRILLING

See Sections 3.2.18 through 3.2.24 for details on quantities.

PART 4
LABOUR AND EQUIPMENT PERFORMANCE AND REQUIREMENTS

4.1 INTRODUCTION

In this Section, equipment and daily manpower requirements are developed. This is done on the basis of the daily ore requirements of 2,500 t. A combination of the operator's past experience and Dynatec's judgment are used to establish basic performance rates.

4.2 STOPE AND MINE DEVELOPMENT FOR BLASTHOLE STOPE AND MECHANIZED CUT AND FILL

4.2.1 LATERAL DEVELOPMENT

.1 General

From previous experience at this particular operator's other mines, it was assumed that, on a two 11 hour shifts/day basis, 6.2 m per day for 3.4 m x 3.4 m heading will be developed with the crew make-up show below. This is equivalent to 3.1 m per crewshift.

Occupation

	Per Shift	Per Day
Jumbo Drillers	2	4
Development Blasters	1	2
Pipe Installers	1	2
Total	4	8

In cases where development work has been converted to equivalent lengths of 3.4 m x 3.4 m heading this assumption has also been used. Equipment comprises 3.8 m^3 scooptram; 2 boom jumbo and a powder truck.

.2 Mine Development

$$\text{949 m required/year} = \frac{949}{365} = 2.6 \text{ m/d}$$

$$\text{Crew shifts required} = \frac{2.6 \text{ m/day}}{3.1 \text{ m/crewshift}} = 0.84 \text{ crewshift}$$

or 3.3 manshifts/day (0.84 x 4)

$$\text{Equipment fleets required @ 100\% availability} \quad \frac{0.84}{2} = 0.42$$

.3 Stope Development

(a) Mechanized Cut and Fill

$$\text{Development required/day} = \frac{0.5 \text{ stopes/year} \times 4712 \text{ m/stope}}{365 \text{ days/year}}$$

$$= 6.46 \text{ m/day}$$

$$\text{Crewshifts Required} = \frac{6.46 \text{ m/day}}{3.1 \text{ m/crewshift}} = 2.2 \text{ crewshifts or 8.8 manshifts/day (2.2 x 4)}$$

$$\text{Equipment fleets required at 100\% availability} = \frac{2.2}{2} = 1.1$$

4.2.1 LATERAL DEVELOPMENT (Cont'd)

(b) Blasthole Stoping

$$\text{Development/Day} = \frac{1.7 \text{ stopes/year} \times 1109 \text{ m/stope}}{365 \text{ days/year}}$$

$$= 5.17 \text{ m/day}$$

$$\text{Crewshifts Required} = \frac{5.17 \text{ m/day}}{3.1 \text{ m/crewshift}} = 1.66 \text{ crewshifts or } 6.64 \text{ manshifts/day}$$

$$\text{Equipment fleets required @ 100\% availability} = \frac{1.66}{2} = 0.83$$

4.2.2 VERTICAL DEVELOPMENT

.1 General

From previous experience assume 1.5 m per crewshift when crew comprises 2 men. Work carried out on a two shifts per day basis. Equipment required is an Alimak Raise Climber.

.2 Mine Development

$$\text{43 m required/year} = \frac{43 \text{ m}}{365 \text{ days}} = \frac{.118 \text{m/day}}{1.5 \text{ m/crewshift}} = 0.08 \text{ crewshifts or } .16 \text{ manshifts/day}$$

.3 Stope Development

(a) Mechanized Cut & Fill (none required for blasthole stoping)

$$\text{Raise work required/day} = \frac{0.5 \text{ stopes/year} \times 252 \text{ m/stope}}{365 \text{ days/year}}$$

$$= .34 \text{ m/day}$$

$$\text{Crewshifts Required} = \frac{.34 \text{ m/day}}{1.5 \text{ m/crewshift}} = .230 \text{ crewshifts or } .460 \text{ manshifts/day}$$

4.3 STOPE DRILLING

4.3.1 MECHANIZED CUT & FILL

(a) 51 mm drill will operate with 2 men per shift, 2 shifts/day

(b) Drill performance of 250 m per shift

(c) Shift is 10½ hours long and drill will operate 8.5 hours

4.3.1 MECHANIZED CUT & FILL (Cont'd)

(d) Performance Calculations

No. of crews required: $\frac{0.5 \text{ stopes/year} \times 228{,}441 \text{ m/stope}}{250 \text{ m/shift} \times 365 \text{ days/year}}$

= 1.26 crewshifts/day

or 2.52 manshifts/day

$\frac{1.26}{2}$ = 0.63 drills are required

4.3.2 BLASTHOLE STOPING

(a) 110 mm drill will operate with 1 man per shift 2 shifts per day.

(b) Drill performance of 45 m per shift

(c) Shift is 10½ hours long and drill will work 8.5 hours per shift

(d) Performance Calculations

Drilling/manshift = $\frac{45 \text{ m/shift}}{1 \text{ man/shift}}$ = 45.0 m/manshift

Drilling required per year:

16,580 m/stope block x 1.7 stope blocks/year = 28,186 m
= 77.2 m/day

Crewshifts required: $\frac{77.2 \text{ m/day}}{45 \text{ m/manshift}}$

= $\frac{1.72}{2}$ = 0.86 drills required

4.4 STOPE BLASTING

4.4.1 MECHANIZED CUT & FILL

(a) Blast crew consists of two men per shift - operations 2 shifts per shift

(b) Crew loads for 8.5 hours per 10.5 hour shift

(c) Performance Calculations:

Rounds with full perimeter drilling:

Loading Time = $\frac{66 \text{ holes} - 6}{2 \text{ men}}$ x 2 min./man/hole + T (Allow 30 min for move in, set up and tear down
= 90 min.

4.4.1 MECHANIZED CUT & FILL (Cont'd)

Allow 30 min. to ventilate face

Total loading and blasting time is 120 min. or 2 hours/round

Rounds with half perimeter drilling:

Loading Time = $\frac{(49 - 6)}{(2)} \times 2 + 30 = 73$ min.

Allow 30 min. to ventilate face.

Total loading and blasting time is 103 min. or 1.7 hours/round

Average loading and blasting time = .2 x 2 + .8 x 1.7 = 1.84 hours/round

Rounds required/day: $\frac{(162 + 648)/\text{year}}{365} = 2.2$

Rounds load/day/crew = $\frac{8.5 \text{ hours/day}}{1.8 \text{ hours/round}} = 4.7$

Crewshifts required: $\frac{2.2}{4.7} = 0.46$ crewshifts/day or 0.92 manshifts/day

Equipment required is a powder truck on a full-time basis.

4.4.2 BLASTHOLE STOPING

(a) Blast crew consists of 1 man

(b) One man can load 665 kg powder per shift

(c) Performance calculations:

Explosives req'd per yr: 89,140 kg/stope x 1.7 stope blocks/yr (See 3.3.6)

= 151,538 kg/year

Crew required: $\frac{151,538 \text{ kg/year}}{665 \text{ kg/day/man shift} \times 365 \text{ days/year}}$

= 0.62 manshifts/day

4.4.3 SECONDARY BLASTING

(a) One man required on each shift for all secondary blasting requirements or two manshifts/day.

4.5 STOPE MUCKING

4.5.1 MECHANIZED CUT & FILL

(a) Assume travel speed to ore pass is 107 m/min

(b) Calculations for Haul Distance/Cycle Time

Table 4.1 shows the derivation of average haul distance for the mechanized cut-and-fill mining on levels and sublevels 6 through 9. Table 4-2 shows the deviation of cycle time and the equipment and manpower requirements.

4.5.2 BLASTHOLE STOPING

(a) Assume travel speed to ore pass is 107 m/min.

(b) Calculations for Haul Distance/Cycle Time:

Blasthole stope muck will come from two mine locations - from the 5th Level (upper stopes) and from the 11th Level (lower stopes). The total number of scooptrams required is based on the upper and lower stopes each requiring enough scooptrams to muck the total daily requirements of 1,038 t (See 3.3.2) per day.

Table 4.2 shows the development of the blasthole mucking cycle and the number of scoops required.

TABLE 4-1

MECHANIZED CUT & FILL AVERAGE HAUL DISTANCE

Level	Ore Pass	Haul Distance (m)	% of Total Level Tonnes (Stope Length) / (St,Bl.Length)	Weighted Average Haul Distance (m)	Level Tonnage	Level Tonnes / Total Tonnes x Weighted Haul Distance
6th Sub Level	1	319	226/290	(226/290) x 319 = 248.6	241,787	241,787 / 2,293,900 x 289.0 = 30.46 m
	2	183	64/290	(64/290) x 183 = 40.4		
				Total 289.0		
6th Level	1	356	213/320	(213/320) x 356 = 237.0	241,788	241,788 / 2,293,900 x 298.9 = 31.51 m
	2	185	107/320	(107/320) x 185 = 61.9		
				Total 298.9		
7th Sub Level	1	257	167/301	(167/301) x 257 = 142.6	288,912	288,912 / 2,293,900 x 242.3 = 30.52 m
	2	224	134/301	(134/301) x 224 = 99.7		
				Total 242.3		
7th Level	1	255	140/305	(140/305) x 255 = 117.1	288,913	288,913 / 2,293,900 x 237.2 = 29.87 m
	2	222	165/305	(165/305) x 222 = 120.1		
				Total 237.2		
8th Sub Level	1	199	104/308	(104/308) x 199 = 67.2	295,437	295,437 / 2,293,900 x 252.0 = 32.46 m
	2	279	204/308	(204/308) x 279 = 184.8		
				Total 252.0		
8th Level	1	132	65/308	(65/308) x 132 = 27.9	295,438	295,438 / 2,293,900 x 214.9 = 27.68 m
	1	237	243/308	(243/308) x 237 = 187.0		
				Total 214.9		
9th Sub Level	1	169	185/302	(185/302) x 169 = 103.5	320,812	320,812 / 2,293,900 x 176.3 = 24.66 m
	3	188	117/302	(117/302) x 188 = 72.8		
				Total 176.3		
9th Level	1	135	147/300	(147/300) x 135 = 66.2	320,813	320,813 / 2,293,900 x 171.3 = 23.96 m
	3	206	153/300	(153/300) x 206 = 105.1		
				Total 171.3		
Total					2,293,900	Average Haul Distance 231.12 m

Say 232 m

TABLE 4-2

BLASTHOLE STOPE SCOOPTRAM AND LABOUR REQUIREMENTS

Location	Average Haul Dist. (AHD) m	Scooptram Cycle Time (Minutes) Load	Travel to OP (AHD)/ 107m/min	Dump	Return to Stope (AHD)	Total Min. per Bucket	Buckets per Shift = (8.5 hrs/ shift x 50 min/hr) ÷ (total min/ bucket)	Tonnes/Shift = buckets per shift x 6.5Tonnes/ bucket	Scooptrams Required = (T/shift required) ÷ (T/shift/ scooptram	*Scooptrams Required @ 60% Availability
Mechanized Cut and Fill Section (1,189 t/d or 598 t/shift)										
	232	1.10	2.17	0.50	2.17	5.94	71	461	1.3	2.2
Blasthole Stoping Section (1,038 t/d or 519 t/shift)										
Upper Stopes										
	144	1.10	1.35	0.50	1.35	4.30	98	637	0.81	1.35
Lower Stopes										
	65	1.10	0.61	0.50	0.61	2.82	150	975	0.53	0.9

Labour Required: Upper Stopes 2 x 0.81 = 1.62 manshifts/day
Lower Stopes 2 x 0.53 = 1.06 manshifts/day

Average = 1.34 manshifts/day

4.6 STOPE GROUND SUPPORT

4.6.1 MECHANIZED CUT & FILL

.1 General

(a) Productivity of 20 rock bolts per manshift

(b) Productivity of 40 meters per manshift to drill cable bolts

(c) Productivity of 10 cable bolts per manshift to install cable bolts

(d) 30 m^3 per manshift to install screen.

.2 Rock Bolts

Number of manshifts/day required for 0.5 stope blocks:

$$\frac{11{,}575 \text{/year}}{20 \text{ rock bolts per manshift} \times 365 \text{ days/year}}$$ (See 3.2.8)

= 1.6 manshifts/day

.3 Cable Bolts

Drilling:

$$\frac{67{,}870 \text{ m/year}}{40 \text{ m/manshift} \times 365 \text{ days/year}}$$ (See 3.2.8)

= 4.6 manshifts/day

Installing:

$$\frac{5{,}220 \text{ cable bolts/year}}{10 \text{ cable bolts/manshift} \times 365 \text{ days/year}}$$ = 1.4 manshifts/day (See 3.2.8)

Screening:

Total screen to install on hanging wall:

294 m long x 100 m high x 10% = 2,940 m^2

Number of men/day required to install screen for 0.5 stope blocks:

$$\frac{2940 m^2 \text{/stope block} \times 0.5 \text{ stope blocks/year}}{30 m^2 \text{/manshift} \times 365 \text{ days/year}}$$ = .13 manshifts/day

Assume screening done by rock bolting crew.

Equipment required is one roof bolt jumbo and one scissor lift to cover rock bolts, cable bolts and screening.

4.6.2 BLASTHOLE STOPING

.1 General

(a) Productivity of 20 rock bolts per manshift
(b) Productivity of 40 m per manshift to drill cable bolts
(c) Productivity of 10 cables bolts per manshifts to install cable bolts

.2 Rock Bolts

No. of manshifts/day: $\frac{2,504/\text{year}}{20 \text{ rock bolts per manshift} \times 356 \text{ days/year}}$ (See 3.3.9)

= 0.4 manshifts/day

.3 Cable Bolts

Drilling: $\frac{7,074 \text{ m/year}}{40 \text{ meters per manshift} \times 365 \text{ days/year}}$ (See 3.3.9)

= 0.5 manshifts/day

Installing: $\frac{969 \text{ moyear}}{10 \text{ cable bolts per manshift } 365 \text{ days/year}}$ (See 3.3.9)

= 0.3 manshifts/day

Equipment required to cover rock bolts and cable bolts is one roof bolt jumbo

4.7 STOPE BACKFILLING

4.7.1 MECHANIZED CUT & FILL

(a) Fill 11 hours/day @ 91 tonnes/hour/man or 1,001 t/day/man

(b) 735 t/d of backfill to replace mined ore (460 m^3 @ 1.6 t/m^3)

(c) Bulkheads constructed by 2 manshifts/day in 4 days

(d) Calculations

Backfill required per day = 735 t

Available per hour: = 91 t

Backfill required for 0.5 stope blocks = $\frac{468,930}{2.9} \times 1.6 = 258,720$ t (See 3.2.2)

Time to fill 0.5 stope blocks = $\frac{258,720 \text{ t}}{1,001 \text{ t/d}}$

258 days

Use same 2 man shifts/day to build the bulkheads and fill the stope blocks.

Equipment required is flatbed truck part-time, therefore 0.5 trucks allowed for.

4.7.2 BLASTHOLE STOPING

(a) Fill 11 hours/day @ 91 t/hour per man or 1,001 t/day per man (Assume filling continues during lunch break)

(b) Assume $3.8m^3$ Scooptrams will haul R.O.M. fill from the level waste passes @ 6.5 tonne bucket capacity

(c) 2 manshifts/day 4 days to construct 1 bulkhead

(d) Scooptram travel speeds

level (full or empty)	107 m/min
up 15% (full)	54 m/min
down 15% (empty)	107 m/min

(e) Calculations - Hydraulic Backfill

Tonnage of backfill required per day = 245 t (See 3.3.10)
Tonnage available per hour = 91 t
Tonnage required for stope block = 52,507 t (See 3.3.10)
Time to fill stope block: $\frac{52,507 \text{ t}}{91 \text{ t/hour/man}}$ = 577 man hours

No. of days to fill stope block = $\frac{577 \text{ man hours}}{11 \text{ hrs/shift}}$ = 53 manshifts
or 53 x 1.7 = 90.1 manshifts/year
= 0.24 manshifts/day

No. of shifts req'd per day:
$\frac{90.1 \text{ manshifts/year}}{365 \text{ days/year}}$

(f) Haulage for R.O.M. Fill

All R.O.M. waste muck for stopes above the 5th Level will come from the waste pass on the 3rd Level. All R.O.M. waste muck for stopes below the 9th Level will come from the 10th Level waste pass.

R.O.M. waste muck will be dumped on the 3rd Level for the upper stopes and on the 10th Level Sub for the lower stopes.

	Upper Stopes (3rd Level) (m)	Lower Stopes (10th Level) (m)
Level haul	536	161
Ramp haul	-	257
Total	536	418

4.7.2 BLASTHOLE STOPING (Cont'd)

Cycle Times

	Upper Stopes (3rd Level)	Lower Stopes (10th Level)
Load Bucket	1.10	1.10
Travel to stope - level haul	5.01	1.50
Travel to stope - ramp (loaded)		4.76
Dump	0.50	0.50
Return to waste pass		
	5.01	-
	-	3.91
Total cycle time	11.62 min/bucket	11.77 min/bucket

	Upper Stopes (3rd to 5th Level)	Lower Stopes (9th to 11th Level)
Assume 8.5 hours/shift, 50/minutes/hour		
Total buckets/shift	$= \frac{8.5 \times 50}{11.62}$	$= \frac{8.5 \times 50}{11.77}$
	= 36 buckets	36 buckets
Tonnes hauled/scoopshift @ 6.5 t/bucket	234	234
Tonnage R.O.M./day (required)	489 t	489 t (See 3.3.10)
Tonnage R.O.M./shift (required)	245 t	245 t
Scoops required @ 100%		
$\frac{245 \text{ t/shift}}{234 \text{ t/scoop-shift}}$	1.05 scoops	1.05 scoops
@ 60% availability	1.75 scoops	1.75 scoops

4.7.2 BLASTHOLE STOPING (Cont'd)

Tonnage R.O.M. waste muck per stope block is 105,013 t (See 3.3.10)

Therefore total tonnage per year is:

1.7 stope blocks x 105,013 t/stope block = 178,522 t

Performance per scoopshift is 234 t

Therefore scoopshifts for 1.7 stope blocks is:

$$\frac{178{,}522 \text{ t}}{234 \text{ t}} = 763 \text{ scoopshifts}$$

No. of men required per day $\frac{763 \text{ scoopshifts/year}}{365 \text{ days/year}}$

= 2.1 manshifts/day (one man per scoop)

4.8 OTHER ACTIVITIES

Labour and Equipment requirements for other support activities have been grouped together, as the requirements are generally independent of the mining activities and production rates derived in the previous paragraphs.

Table 4-3 summarizes the equipment and labour requirements for each of these activities.

4.9 EQUIPMENT FLEET

Tables 4-4 and 4-5 summarize the equipment fleet developed in the preceeding Sections of this Part of the report for Mechanized Cut and Fill and Blasthole Stope Mining, respectively.

4.10 MAINTENANCE LABOUR

Maintenance Labour for all major equipment has been assumed to be 0.75 times the required number of pieces of diesel operated mobile equipment. Maintenance labour for other items of equipment are based on the operators previous experience. Table 4-6 summarizes these requirements for both Mechanized Cut and Fill and Blasthole Stoping sections.

4.11 OPERATING LABOUR

Table 4.7 summarizes the daily labour requirements for both mining sections. The sections of this report from which the figures are derived are indicated in parentheses. For rounding purposes, this table has been shown to the nearest ½ man for each mining section and/or the nearest man for both sections combined.

TABLE 4-3
OPERATING LABOUR AND EQUIPMENT REQUIREMENTS
FOR MISCELLANEOUS ACTIVITIES

Activity	Mechanized Cut & Fill		Blasthole Stoping		Total	
	Equipment	Operating Labour/Day (Manshifts)	Equipment	Operating Labour/Day (Manshifts)	Equipment	Operating Labour/Day (Manshifts)
Roadbed Preparation and Maintenance	½ Grader	1	½ Grader	1	1 Grader	2
U/G Jaw Crusher	-	1	-	1	-	2
Conveying	½ Bobcat Loader	1½	½ Bobcat Loader	1½	1 Bobcat Loader	3
Hoisting	-	-	-	-	-	-
hoistmen	-	2	-	2	-	4
deckmen	-	1	-	1	-	2
cage tenders	-	1	-	1	-	2
skip tenders	-	1	-	1	-	2
Mine Services						
utility vehicle	½	1	½	1	1	2
flatbed truck	1½	1½	1½	1½	3	3
dozer	½	½	½	½	1	1
lube & services	½	1	½	1	1	2
scissor lift	1	2	1	2	2	4
electrician	-	2		2		4
general labour	-	2		2		4
level mtce/cleanup	-	1		1		2
Fuel	-	½		½		1
Tires	-	½		½		1
Pumping	-	½		½		1
Ventilation	-	½		½		1
Rail Haulage	4.5(loco&minecars)	1	4.5(loco&minecars)	1	9(loco & minecars)	2
Diamond Drilling (Subcont.)	-	-		-		-
TOTALS		22½		22½		45

TABLE 4-4
EQUIPMENT FOR MECHANIZED CUT AND FILL SECTION

OPERATION	3.8m³ Scoop-tram r+s=t	2 Boom Jumbo r+s=t	Scis-sor Lift r+s=t	Flat-bed r+s=t	Powder Truck r+s=t	Grader ____ r+s=t	Utility Vehicle r+s=t	Dozer ____ r+s=t	Small Loader r+s=t	Roof-Bolt Jumbo r+s=t	Lube & Service r+s=t	Loco r+s=t	O&K Cars r+s=t	Total t
Mine Lat. Dev. (½ for each mining section)	.21+.14 = .35	.21+.14 = .35			.21+0 = .21									0.91
Stope Dev.	1.1+.70 = 1.80	1.1+.70 = 1.80			1.1+0 =1.10									4.70
Stope Drilling		.63+.42 = 1.05												1.05
Stope Blasting					1+0=1									1.00
Stope Mucking	1.3+.9 = 2.2													2.20
Ground Control			1+0=1							1+0=1				2.00
Backfill				.5+0=.5										0.50
Road Bed Maint.						.5+0=.5								0.50
U/G Crusher														-
Conveying									.5+0=.5					0.50
Hoisting														
Mine Services			1+0=1	1.5+0 = 1.5			.5+0 = .5	.5+0 = .5			.5+0 = .5			4.00
Fuel														-
Tires														-
Mine Air Heating														-
Pumping														-
Electric Power														-
Ventilation														-
Rail Haulage												1+0=1	3.5+0 = 3.5	4.50
Ore Passes														-
Total Required	2.61	1.94	2.0	2.0	2.31	0.5	0.5	0.5	0.5	1.0	0.5	1.0	3.5	18.56
Total Spares	1.74	1.26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.00
Grand Total	4.35	3.20	2.0	2.0	2.31	0.5	0.5	0.5	0.5	1.0	0.5	1.0	3.5	21.86
Actual Required	3.0	2.0	2.0	2.0	2.5	0.5	0.5	0.5	0.5	1.0	0.5	1.0	3.5	19.50
Actual Spares	2.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.00
Grand Total	5.0	3.0	2.0	2.0	2.5	0.5	0.5	0.5	0.5	1.0	0.5	1.0	3.5	22.50

r = required at 100% availability s = spare t = Total

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TABLE 4-5
EQUIPMENT FOR BLASTHOLE STOPING SECTION

OPERATION	3.8m³ Scoop-tram r+s=t	2 Boom Jumbo r+s=t	Scis-sor Lift r+s=t	Flat-bed r+s=t	Powder Truck r+s=t	Grader r+s=t	Utility Vehicle r+s=t	Dozer r+s=t	Small Loader r+s=t	Roof-Bolt Jumbo r+s=t	Lube & Service r+s=t	Block-hole Drill r+s=t	Loco r+s=t	O&K Cars r+s=t	Mis-sion Drill r+s=t	Total t	
Mine Lat. Dev.	.21+.14 = .35	.21+.14 = .35			.21+0 = .21												
Stope Dev.	.83+.55 = 1.38	.83+.55 = 1.38			.83+0 = .83											0.91	for both mining Sections
Stope Drilling																3.59	
Stope Blasting															.86+.34 = 1.2		
Stope Mucking	.67+.45 = 1.12															1.20	
Secondary Blasting																-	
Ground Control																1.12	
Backfill												1+0=1				1.00	
Road Bed Maint.	1.05+.70 =1.75									1+0=1						1.00	
U/G Crusher				1+0=1												2.75	
Conveying						.5+0=.5										0.50	
Hoisting																-	
Mine Services									.5+0=.5							0.50	
Fuel			1+0=1	1.5+0 = 1.5			.5+0 = .5	.5+0 = .5			.5+0 = .5					-	
Tires																4.00	
Mine Air Heating																-	
Pumping																-	
Electric Power																-	
Ventilation																-	
Rail Haulage																-	
Ore Passes													1+0=1	3.5+0 = 3.5		4.50	
Total Required	2.76	1.04	1.0	2.5	1.04	0.5	0.5	0.5	0.5	1.0	0.5	1.0	1.0	3.5	0.86	-	
Total Spares	1.84	0.69	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.34	18.20	
Grand Total	4.60	1.73	1.0	2.5	1.04	0.5	0.5	0.5	0.5	1.0	0.5	1.0	1.0	3.5	1.2	2.87	
Actual Required	3.0	2.0	1.0	3.0	1.5	0.5	0.5	0.5	0.5	1.0	0.5	1.0	1.0	3.5	2.0	21.07	
Actual Spares	2.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.50	
Grand Total	5.0	3.0	1.0	3.0	1.5	0.5	0.5	0.5	0.5	1.0	0.5	1.0	1.0	3.5	2.0	3.00	
																24.50	

r = required at 100% availability s = spare t = Total

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TABLE 4-6

EQUIPMENT MAINTENANCE LABOUR REQUIREMENTS

Operation	Total Equipment MCF	Total Equipment BHS	Total For Mine		Maintenance Labour MCF	Maintenance Labour BHS	Total
Mine Lat. Dev.	0.91	0.91	1.82		0.68	0.68	1.36
Stope Lat. Dev.	4.70	3.59	8.29		3 53	2.69	6.22
Stope Drill. (110 mm)	-	1.20	1.20		-	0.90	0.90
Stope Drill. (51 mm)	1.05	-	1.05		0.79	-	0.79
Stope Blasting	1.00	-	1.00		0.75	-	0.75
Stope Mucking	2.20	1.12	3.32		1.65	0.84	2.49
Secondary Blasting	-	1.00	1.00		-	0.75	0.75
Ground Control	2.00	1.00	3.00		1.50	0.75	2.25
Backfill	0.50	2.75	3.25		0.38	2.06	2.44
Road Bed Maint.	0.50	0.50	1.00		0.38	0.38	0.76
U/G Crusher	-	-	-		1.50	1.50	3.00
Conveying	0.50	0.50	1.00		0.38	0.38	0.76
Hoisting	-	-	-		1.50	1.50	3.00
Mine Services	4.00	4.00	8.00		3.00	3.00	6.00
Fuel	-	-	-		-	-	-
Tires	-	-	-		-	-	-
Mine Air Heating	-	-	-		-	-	-
Pumping	-	-	-		-	-	-
Electric Power	-	-	-		2.5	2.5	5.0
Ventilation	-	-	-		0.5	0.5	1.0
Rail Haulage	4.50	4.50	9.00		1.0	1.0	2.0
Ore Passes	-	-	-		-	-	-
Total	21.86	21.07	42.93		20.04	19.43	39.47
				Say	20.00	19.00	39.00

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TABLE 4-7

OPERATING LABOUR REQUIREMENTS
(MAN SHIFTS REQUIRED PER DAY)

Activity	M.C.F. Section	B.H.S. Section	Total Operating Labour
Mine Development	2.0 (4.2.1)	2.0 (4.2)	20.0
Stope Development	9.5 (4.2.1)	6.5 (4.2.1)	
Stope Drilling 110 mm	-	2.0 (4.3.2)	2.0
Stope Drilling 51 mm	3.0 (4.3.1)		3.0
Stope Blasting	1.0 (4.4.1)	1.0 (4.4.2)	2.0
Stope Mucking	2.5 (4.5.1)	1.5 (4.5.2)	4.0
Secondary Blasting		2.0 (4.4.3)	2.0
Ground Control	8.0 (4.6.1)	1.0 (4.6.2)	9.0
Backfill	2.0 (4.7.1)	4.0 (4.7.2)	6.0
Roadbed Maintenance	1.0 (4.8)	1.0 (4.8)	2.0
Underground Jaw Crusher	1.0 (4.8)	1.0 (4.8)	2.0
Conveying	1.5 (4.8)	1.5 (4.8)	3.0
Hoisting	5.0 (4.8)	5.0 (4.8)	10.0
Mine Services	11.0 (4.8)	11.0 (4.8)	22.0
Fuel	0.5 (4.8)	0.5 (4.8)	1.0
Tires	0.5 (4.8)	0.5 (4.8)	1.0
Mine Air Heating	-	-	-
Pumping	0.5 (4.8)	0.5 (4.8)	1.0
Electric Power	-	-	-
Ventilation	0.5 (4.8)	0.5 (4.8)	1.0
Rail Haulage	1.0 (4.8)	1.0 (4.8)	2.0
Diamond Drilling (Sub Contract)	- (4.8)	- (4.8)	-
Total	50.5	42.5	93.0

PART 5
CAPITAL COSTS

5.1 GENERAL

Capital costs are covered under the three separate headings of mining equipment purchases, surface facilities and pre-production development. The costs have been developed by a combination of methods.

Equipment costs are based on recent quotations from manufacturers and include all taxes and delivery charges. Capital costs for surface plant are a combination of unit rates for surface construction based on consultant's experience, manufacturers quotations for equipment and contracted prices.

Pre-production development costs have been prepared using contracted prices for the work. Of course, a contractor develops prices for this type of work using the same 'first-principles' basis that is illustrated in this report for the mine operating costs. It is beyond our project scope to provide full details for this category of work as most of it is carried out on a once-only basis. The nature of much of the pre-production development work is similar to on-going mining work and the reader could derive most of the prices using the same approach.

5.2 MINING EQUIPMENT PURCHASES

.1 MECHANIZED CUT AND FILL OPERATIONS

Table 5-1 lists the types, quantities and prices for equipment purchases required on the mechanized cut and fill section of the work. The numbers in parenthesis are the estimated lives of the various items of equipment in years. The number of times each item must be replaced during the life of the mine is also indicated.

.2 BLASTHOLE STOPE OPERATIONS

Table 5-2 lists the types, quantities and costs for the equipment required for blasthole stoping operations.

5.3 SURFACE FACILITIES

Figure 5-1 shows a layout of the surface plant required to support the underground operation. The capital costs for each of the structures are as follows:

TABLE 5-1

MECHANIZED CUT AND FILL CAPITAL EQUIPMENT COSTS

Equipment	No. of Units				
Mobile	Required for Initial Operation	Replacement Units for Remainder of Project	Cost/Unit	Initial Capital Costs	Replacement Capital Costs
2 Boom Jumbos (7)	3.0	-	$362,393.00	$1,087,179.00	$ -
3.8 m^3 Scooptrams (3)	5.0	5.0	199,613.00	998,065.00	998,065.00
Flatbeds (7)	2.0	-	74,950.00	149,900.00	-
Roof Bolting Jumbo (7)	1.0	-	315,000.00	315,000.00	-
Scissor Lift Truck (7)	2.0	-	90,000.00	180,000.00	-
Grader (7)	0.5	-	167,000.00	83,500.00	-
Utility Vehicle (7)	0.5	-	14,698.00	7,349.00	-
Lube & Service Vehicle (7)	0.5	-	95,760.00	47,880.00	-
1.8 m^3 Loader (Bobcat) (7)	0.5	-	87,000.00	43,500.00	-
Powder Truck (7)	2.5	-	103,740.00	259,350.00	-
Total	17.5	5.0		$3,171,723.00	$ 998,065.00
Other					
D4 Dozer (7)	0.5	-	$ 73,000.00	$ 36,500.00	-
8 Ton Battery Locomotive Plus 3 Batteries (7)	1	-	120,100.00	120,100.00	-
10 Tonne O&K Cars (7)	3.5	-	30,000.00	105,000.00	-
Jacklegs & Stopers (7)	10	-	2,500.00	25,000.00	-
Total	15.0	-		$ 286,600.00	$ -
Grand Total	32.5	5.0		$3,458,323.00	$ 998,065.00
			Say	$3,458,000.00	$ 998,000.00

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TABLE 5-2

BLASTHOLE STOPE CAPITAL EQUIPMENT PURCHASES

Equipment	Required For Operation	Replacement Units For Remainder of Project	Cost/Unit	Initial Capital Costs	Replacement Capital Costs
Mobile					
2 Boom Jumbos (7)	3.0	-	$362,393.00	$1,087,179.00	$ -
3.8 m^3 Scooptrams (5)	5.0	5.0	199,613.00	998,065.00	998,065.00
Flatbeds (7)	3.0	-	74,950.00	224,850.00	-
Block Hole Drill (7)	1	-	85,250.00	85,250.00	
Roof Bolting Jumbo (7)	1	-	315,000.00	315,000.00	-
Scissor Lift Truck (7)	1	-	90,000.00	90,000.00	-
Grader (7)	0.5	-	167,000.00	83,500.00	-
Utility Vehicle (7)	0.5	-	14,698.00	7,349.00	-
Lube & Service Vehicle (7)	0.5	-	95,760.00	47,880.00	-
1.8 m^3 Loader (Bobcat) (7)	0.5	-	87,000.00	43,500.00	-
Powder Truck (7)	1.5	-	$103,740.00	155,610.00	-
Total	17.5	5.0		$3,138,183.00	$ 998,065.00
Other					
D4 Dozer (7)	0.5	-	$ 73,000.00	$ 36,500.00	$ -
8 Ton Battery Locomotive Plus 3 Batteries (7)	1	-	120,100.00	120,100.00	-
10 Tonne O&K Cars (7)	3.5	-	30,000.00	105,000.00	-
TRW Mission Drill c/w Compressor (7)	2	-	155,000.00	310,000.00	-
Jacklegs & Stopers (7)	10	-	2,500.00	25,000.00	-
Total	17.0	-		$ 596,600.00	$ -
Grand Total	34.5	5.0		$3,734,783.00	$ 998,065.00
			Say	$3,735,000.00	$ 998,000.00

5.3. SURFACE FACILITIES (Cont'd)

Structure or Facility	Cost
Headframe & Shafthouse	2,150,000
Hoisthouse	3,475,000
Compressor Room	435,000
Ventilation Building	96,000
Dry Building/Offices	2,590,000
Surface Conveyor	450,000
Backfill Plant	1,670,000
Site Works	2,310,000
Concrete Batch Plant	300,000
Hoists (ship, service, sinking)	3,411,000
Compressors	695,000
Sewage Treatment Plant	100,000
Total	$17,682,000

5.4 PRE-PRODUCTION DEVELOPMENT CAPITAL COSTS

5.4.1 GENERAL

This section covers the capital costs for all mine access works, underground construction and pre-production development work. Figure 3-6 shows a general longitudinal section which indicates all the work covered under this heading. The appropriate quantities and costs for this work are given in the following paragraphs.

5.4.2 SHAFT SINKING

.1 Shaft Sinking Materials
710 m Deep, 294 Sets

294 Sets @ $1,398	411,012
False Posts 60 @ $124	7,440
Bearing Sets 116 @ 108.33	12,566
Shaft Bottom Sets	1,300
Lip Pocket Timber	7,500
Spill Pocket	2,010
Blocking	39,000
Wedges	4,000
Ladders 156 @ $61.50	9,594
Cage/Cwt Guides, 628 @ $110	69,080
Cage/Cwt Guides - Headframes	5,500
Karri Mine Guides 408 @ $235	95,880
Karri Mine Guides - Headframe	5,500
Misc. Timber	33,551
Chain Link Fencing	29,547
Sub Total (Timber)	$733,480

.1 Shaft Sinking Materials (Cont'd)

Hardware Grating, Rods, etc.			126,000
Shaft Station Doors, 38 @ $3,500			133,000
Survey Equipment			3,000
Nuts, Washers, Nails			35,400
Cage Chairs, 1 set/station			6,000
Sub Total (Hardware)			303,400
Pipe and Fittings	Sub Total		229,590
Rocbolts (4,200)			13,900
Grout Plugs - Cement			3,000
Rebar Bolts, 2,000 @ $8.51			17,000
Epoxy			12,780
Bulkhead Steel			24,000
Sinking Ropes, Thimble			35,120
Vent Duct, 710 @ $75			53,250 Sub Total
(Misc.)		159,050	
TOTAL (Shaft Sinking Materials)			$1,425,520
		Say	$1,426,000

.2 Shaft Sinking Contractor Services

1.	Pilot Hole	79,000
2.	Shaft Collar - Excavation	50,000
	- Rockwork Concrete	235,000
3.	Shaft Sinking - 690 m @ $4,540	3,132,600
	- Mob., Demob., etc.	390,000
4.	Shaft Stations - 8,659 m^3 @ $143/sta.	1,238,237
	- Spill Lip Pockets 744 @ $94ea	69,936
5.	Ground Support - Bolts 4,200 @ $17 ea	71,400
	- Screen 1,570 @ $14.50/$m^2$	22,765
	- Straps 300 @ $9.00 ea	2,700
	- Rebar 2,000 @ $25.00/lb.	50,000
6.	Rock Catchers - 48 @ $1200 ea	57,600
	- Bottom Posting	39,000
7.	Bucket/Skip/Cage Changeover	70,000
8.	Cost Plus Work 5% of 3,4,5 .05 x 4,977,638	248,882
9.	Contingencies @ 10% of 3,4,5,8 .1 x 5,226,520	522,652
10.	Install Bulkhead	90,000

.2 Shaft Sinking Contractor Services (Cont'd)

11. Surface Waste Disposal 89,000 T @ $.77		68,500
12. Temp Pump Const. and Install. on Level		22,500
Total Shaft Sinking Contractor		$6,460,772
	Say	$6,461,000

5.4.3 MINE SERVICES

.1 Materials & Equipment

Conveyances

3 - 11 t Skips @ $94,150/skip		282,450
2 - 3,855 kg Service Cage		96,115
7,710 kg c/weight @ $2.00		34,000
3 - 6 t Temp. Skips		196,308
Freight		5,400
	Sub Total	614,273

Sheaves and Ropes

3 - 3.81 m P.D. Fab. Sheaves		236,250
3 - 3.05 m P.D. Bicycle Sheaves		(inc. w. hoist)
3 - 38 mm, 787 m, F.S. Rope		60,450
3 - 31.8 mm 878 m F.S. Rope		65,130
38 m Rope Thimbles		4,360
44.5 m Rope Thimbles		5,200
All items include freight		
	Sub Total	371,390

Loading, Spill, Lip Pockets

Double Cpt 5.8 m^3 Pocket		152,250
2-Load Cells		36,750
Freight		2,750
	Sub Total	191,750
Temp. Loading Pocket on 5th Level for 6 t Skips	Sub Total	94,500
Spill Pocket Timber		2,100
Spill Pocket Door, Cylinder		10,000
Spill Pocket Hardware		8,000
	Sub Total	20,100
Lip Pocket Timber (6 pockets)		45,000
Lip Pocket Hardware (6 pockets)		48,000
	Sub Total	93,000

.1 Materials & Equipment (Cont'd)

Mine Ventilation

Main Fan, 117,987 L/s @ 200 mm		50,000
Sinking Fan 29¼ - 14 - 1770		3,500
22 MBTU/Hr Propane Heater		42,000
4 MBTU/Hr Propane Heater		14,150
Fresh Air Raise Fan, 47,195 L/s 150 mm		12,000
U/G Directional Fans		32,000
U/G Vent Doors, 15 @ $2,000 ea		30,000
Surf. Vent Building		66,822
Vent Ducting 4,200 m @ $15.91/m		2,210
Vent Duct Clips		28,334
Development Fans		8,400
Vent Regulations, 7 @ $1,200 ea		6,000
Measuring Equipment		
	Sub Total	295,416
Escapeway Steel	Sub Total	248,600

Mine Dewatering Pumps

2 - 26.5 L/s M & P Pumps @ $362/m		45,116
2 - 26.5 L/s M & P Pumps @ $322/m		19,593
2 - Flyts 11.4 L/s @ 70 m (Shaft Btm)		13,430
2 - 49.25 L/s M & P Pit Pumps		37,700
1 - Mars Sludge Pump 3.8 L/s		250,000
Freight for Mars Pump		6,000
	Sub Total	371,839

U/G Conveyor

1067 mm Conveyor w Drive - 50.3 m		53,000
3 Feeders @ 21,000 ea		63,000
Structural Steel		137,800
3 Arc Gate Chutes @ $12,000 ea		36,000
Cylinders		12,000
Sump Pump		4,000
	Sub Total	305,800

U/G Crusher

1220 mm x 1529 mm Weldmet Crusher		455,000
Grizzly Feeder		41,000
20 t OH Crane		35,000
Dust Collector		32,000
Structural Steel, Chutes		274,800
Misc. - Safety Car, Air Cylinders		11,000
Arc Gate Chains		4,000
Rock Bolts, Screen		4,320
Freight 20 Loads @ $1,400/load		28,000
	Sub Total	885,120

.1 Materials & Equipment (Cont'd)

4 - 48 Cell Batteries		48,000
2 - Battery Chargers		18,000
2 - 8 T Battery Locos		198,000
2 - Battery Boxes		6,200
8 - 7.1 m^3 O&K Cars		120,000
2 - Dump Stations		104,000
4 - LKAB Type Chutes		204,490
900 m - 36.3 kg Track $0.19/kg		33,100
Steel, Ties, Clips		47,232
Switches		25,000
Ballast 700 m^3 @ $8.00/$m^3$		5,600
Track Tools		20,600
Spikes, Misc.		15,000
Remote Control on Loco		17,600
	Sub Total	862,822
Backfill Distribution		
Pipe and Fittings		76,936
Inserts		13,000
Drain Holes 400 m @ $82/m		32,800
	Sub Total	122,736
U/G Lunchrooms		
Equipment 14 sta. @ $3,000 ea		42,000
Toilets 10 sta. @ $2,000 ea		20,000
	Sub Total	62,000
Cold Storage Building		
Building 12 m x 30.5 m x 4.3 m, erected		67,000
Fencing		10,000
	Sub Total	77,000
Core Racks	Sub Total	30,000
Total Materials & Equipment		$4,646,346
		Say $4,646,000

.2 Underground Construction & Installation

Loading Pocket		
Loading Pocket Installation		99,030
Spill Pocket, Lip Pocket Installation		
Spill Pocket (1)		57,268
Lip Pockets (6)		126,675
	Sub Total	183,943
Remove Sinking Vent Duct		
25 manshift @ 352/manshift		8,800

Changeover to Skip Hoist		
Remove 3.1 m Cage Sheaves and Install 3.7 m Skip Sheaves		8,000
Rope Up Skip Hoist		9,000
Install Skips, Scrolls, Cage Counterweight		25,000
Misc. Tools		3,000
	Sub Total	45,000
Installations of Fans and Vent Doors		
U/G Fans (10)		28,160
Doors 15 @ $7,500/door		112,500
	Sub Total	140,660
Main Fan and Return Air Raise Fan $76,200 + $19,300 =		95,500
Mine Dewatering Pumps and Dams		
Shaft Bottom Pump		4,814
4th, 6th Level Sump Const. and Pump Installation		66,688
3rd Level Pit Dewatering Pumps		33,400
Mars Pump Mech. Installation		25,000
Mars Pump Civil 36 m^3 @ $1,180/$m^3$		42,480
	Sub Total	172,382
U/G Conveyor and Feeders Installation		
Mech. and Structural		68,000
Concrete		30,680
	Sub Total	98,680
U/G Crusher Installation		
Mechanical Installation		303,000
Concrete		21,900
Ground Support		7,765
	Sub Total	332,665
U/G Rail Haulage System - 12 Level		
LKAB Chutes 4 @ $15,000 ea		60,000
Ore and Waste Pass Dumps		60,000
Track		211,200
Switches		11,200
Charging Stations		15,000
Lower and Install Cars, Locos		5,000
	Sub Total	362,400

Backfill Distribution and Drain Holes

Drill Backfill Holes		47,600
Ream Holes to 200 mm		1,750
Install Pipes and Connection Hose		65,000
Install Inserts		55,000
	Sub Total	169,350

U/G Shaft Stations

Station Prep. and Equip 13 @ $17,400		226,200
Station Doors 13 stations @ 4 doors/sta. x $352 ea		18,304
	Sub Total	244,504

Grizzly and Rockbreaker

Concrete		21,300
Mechanical		31,200
	Sub Total	52,500

U/G Shop

Concrete 42 m^3 x 2 shops @ $234/$m^3$		19,656
Labour 56 ms @ $352/ms		19,712
	Sub Total	39,368

Refuge Stations

Concrete 9 x 2 m^3 @ $234/$m^3$		4,212
Labour 9 x 10 ms @ $352/ms		31,680
	Sub Total	35,892

Ore Waste Pass Controls		10,000
Total Underground Construction & Installation		$2,090,674
	Say	$2,091,000

5.4.4. MINE DEVELOPMENT

.1 Materials

150 mm Air Line 11,800 m @ $32/m		377,600
50 mm Water Line 11,800 m @ $8.33/m		98,333
150 mm Vic Couplings 1,966 @ $18		35,388
50 mm Vic Couplings 1,966 @ $5.20		10,223
Fittings @ 5% of Pipe		26,077
Vent Fans		In Vent
Vent Ducting		In Vent
Electric Cable		In Elect.
Explosives and Accessories		By Contractor
J. Hooks, Chain, Eye Bolts		12,000
Timber for Raises 50 MBF @ 400		20,000
Rockbolts 39,000 @ $3.26		127,140
	Sub Total	706,771

.1 Materials (Cont'd)

Aggregate, Sand for Concrete		104,000
Grizzly		50,200
Rockbreaker		85,000
Sinking Bulkhead Steel		26,000
	Sub Total	265,200
Electrical Equipment	Sub Total	2,434,216
	Total Materials	$3,406,187
	Say	$3,406,000

.2 Contractor Services

Item	Size (h x w)	Quantity m/m³	Unit Price $/m or m³	Cost $
Station By-Pass	3.0 x 3.4	319	1,300	414,700
Haulage X-Cut	3.4 x 4.3	1,323	1,395	1,845,585
Main Level Dr.	3.4 x 4.3	4,386	1,180	5,175,480
Access X-Cut	2.7 x 3.1	2,344	965	2,261,960
D.D. Bays	3.4 x 3.4	649	1,100	713,900
Decline	3.4 x 4.3	2,823	1,395	3,938,085
Waste Raise	1.8 x 1.8	1,157	950	1,099,150
Muck Bays	3.4 x 4.3	132	1,180	155,760
Safety Bays (16)	3m³	193m³*	115	22,195
Access X-Cut	3.4 x 3.4	1,443	1,090	1,572,370
Slot Drift	3.4 x 3.7	222	1,090	241,980
Silling Slot Drift (1075)		12,429m³*	115	1,429,335
Sub Level Drift	3.4 x 3.4	2,031	1,090	2,213,790
Slot Raises	1.8 x 1.8	727	885	643,395
Ore Pass Raises	2.4 x 2.4	1,014	1,050	1,064,700
Stulled Raise	1.5 x 1.5	416	950	395,200
Slash Settling Cones (76)		876m³*	125	109,500
Ground Support	1.8 bolts	25,659	20	513,180
Screen		2,909m²	20	58,180
			Total	$23,868,945
			Say	$23,869,000

*(1,167 Equivalent m of 3.4 x 3.4 drift)

5.4.4 WASTE PASSES, VENTILATION RAISES - CONTRACTOR RAISEBORING SERVICES

Item	Size	Quantity	Unit Price $/m	Cost $
Fresh Air Raise	3mØ	607m	1,270	770,890
Return Air Raise	1.8mØ	546m	970	529,620
Waste Pass	1.8mØ	360m	970	349,200
				$1,649,710
			Say	$1,650,000

5.4.6 SUMMARY OF CAPITAL COST

Table 5-3 summarizes the capital costs for the mine and related facilities.

TABLE 5-3

CAPITAL COST SUMMARY

ITEM		INITIAL COSTS $	REPLACEMENT COSTS $
Mining Equipment	MCF Section	3,458,000	998,000
Mining Equipment	BHS Section	3,735,000	998,000
Surface Facilities		17,682,000	-
Pre-Production Development			
	Shaft Sinking Materials	1,425,520	-
	Contractor Services	6,461,000	-
Mine Services			
	Materials and Equipment	4,646,000	-
	Underground Construction	2,091,000	-
Lateral Development			
	Materials	3,406,000	-
	Contractor Services	23,869,000	-
Waste Passes, Ventilation Raises			
Raiseboring Contractor Services		1,650,000	-
TOTAL CAPITAL COST		68,423,520	1,996,000

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PART 6
OPERATING COSTS

6.1 LABOUR

6.1.1 MANAGEMENT, ENGINEERING AND SUPPORT SERVICES

.1 General

This section lists the numbers and annual expenditures for Mine Management, Engineering and outside support services. Also included are annual costs for vehicle and miscellaneous office services consumed by the personnel.

.2 Management (including 35% for fringe benefits)

	$
Mine Superintendent (1) Assistant Superintendent (1) Helper (1)	240,000 annually

.3 Engineering (including 35% for fringe benefits)

Chief Engineer, Chief Geologist (2)	150,000
Geologist	90,000
Senior Engineer (50%)	30,000
Planning Engineer	45,000
Senior Design Draftsman	45,000
Surveyors (2)	75,000
Chief Surveyor (20%)	9,000
	444,000 annually

.4 Services

Allow mechanic, electrician for 25% of their time @ $219/day each. (See 6.1.2.41) 2 m.p.d. x 30 d.p.m. @ $219 = $13,140/mo @ 25% utilization/year use 12 x .25 x 13,140 =	39,420 annually
Sub Total Management & Engineering	723,420 annually
or $0.793/t	or 1,981.97/day

Surface Plant Eng. Design	499,325
Geotechnical Work	22,000
Feasibility Study	84,000
Hoist Evaluation and Inspection	15,694
Rock Mechanics	15,000
Backfill Testing	20,000
Mine Dry Design Completion	30,000
No. 4 Conveyor Design Completion	38,000
Backfill Design Engineering	105,000
Field Supervision, Plant Const.	240,000
Sub Total	1,069,019

6.1.1 MANAGEMENT, ENGINEERING AND SUPPORT SERVICES

.6 Supplies & Expenses (annual expenditures)

Management Vehicles & Expenses	20,000
Engineering Supplies & Expenses	17,000
Hydro	261,000
Propane	45,000
Telephone	12,000
Yard Services	24,000
Truck Rental	5,000
Truck Maintenance	2,400
Truck Fuel	8,000
Building Maintenance	12,000
	406,400
Sub-Total Support Services	$1,475,419
or	$1.617/t

6.1.2 OPERATING LABOUR

.1 Labour Rates

Labour costs are developed on the basis of five categories of labour at the base pay rates, distribution and the share of bonus as indicated in Table 6-1 below.

TABLE 6-1 LABOUR RATES

Direct Labour Rates Grade	Base Rate	Bonus % of Base Rate	Work Force Distribution
1	$15.59	35	25%
2	14.12	30	15%
3	13.46	25	15%
4	12.73	0	20%
5	12.08	0	25%

.2 Fringe Benefits

Allow 30% of earnings to cover holidays with pay, Workmen's Compensation payments, company portion of Canada Pension Plan, company portion of Unemployment Insurance Contributions, Health and Insurance Plans. The actual percentage of some of these items varies according to earnings but based on $40,000 per year, a mining company will pay approximately the following:

Vacation	4%
Statutory Holidays	4%
UIC	1.9%
CPP	0.95%
OHIP	0.89%
Group Insurance WCB and other benefits	18.26%
TOTAL	30.00%

.3 Shift Arrangements

The following working schedule has been developed for this mining operation:

7 days work
7 days leave
11 hour shifts
less ½ hour lunchbreak/shift (unpaid)
10½ hours paid per shift
Assume overtime costs add 4% to base rates

(N.B. Labour works 7 x 10½ hrs/two weeks equivalent to 36-3/4 hours/week). Because of this unusual shift arrangement 365 days per year will be worked.

.4 Daily Labour Rate Calculations

.41 Direct Operating and Maintenance Labour Rates

Grade	(1) Distribution	Base Rate $	O.T. @ 4% $	Total $	Burdens @30% $	Bonus $	(2) Total $	(1) x (2) $
1	25%	15.59	0.62	16.21	4.86	5.46	26.53	6.633
2	15%	14.12	0.57	14.69	4.41	4.24	23.34	3.501
3	15%	13.46	0.54	14.00	4.20	3.37	21.57	3.236
4	20%	12.73	0.51	13.24	3.97	0	17.21	3.442
5	25%	12.08	0.48	12.56	3.77	0	16.33	4.083

Average direct labour rate/hour 20.895
Average rate/day @ 10.5 hrs/day = $219.40

Section 6.3.1 gives details of direct labour costs by category of work.

.42 Indirect Operating & Maintenance Labour

Operating Supervision	Number	Rate/Mo./ Man $	Total/ Month $	Total/ Year x 12	Total/ Day
Asst. Supt.	1	4,330.00	4,330.00	51,960.00	142.36
General Foremen	2	4,758.00	9,516.00	114,192.00	312.86
Foremen	7	4,355.00	30,485.00	365,820.00	1,002.25
	10	14,443.00	45,331.00	543,972.00	1,457.47

For Mechanized Cut & Fill and Blasthole Stopes 5 (avg.) each $\frac{\$1,457.47}{2,500}$ or $0.583/t

Maintenance Supervision					
Ass. Supt.	1	4,330.00	4,330.00	51,960.00	142.36
General Foreman	1	4,758.00	4,758.00	57,096.00	156.43
Foremen	3	4,355.00	13,065.00	156,780.00	429.53
	10	14,443.00	23,153.00	277,836.00	728.32

For Mechanized Cut & Fill and Blasthole Stopes 2.5 (avg.) each $\frac{\$728.32}{2,500}$ or $0.291/t

6.2 OPERATING AND MAINTENANCE SUPPLIES

6.2.1 GENERAL

The costs of operating and maintenance supplies have been developed from the unit prices in the following paragraphs. Generally these were established by receiving quotations from suppliers or from experience in similar operations.

6.2.2 DRILLING (DEVELOPMENT)

Drill String	Unit Cost $/m	Life (m)	Cost/m $
4.5 cm dia. bit	$82.78	91	$0.910
3.66 m drill rod	155.21	305	0.509
3.2 cm rope coupling	31.23	457	0.068
3.2 cm shank adaptor	157.64	914	0.172
Lubrication		Use	0.030
Bit sharpening		Use	0.131
		Total Cost/Meter	$1.820

Raise drilling (stopers) costs from files $1.97/m

6.2.3 STOPE DRILLING (MECHANIZED CUT & FILL SECTION)

Drill String	Unit Cost $/m	Life (m)	Cost/m $
5.1 cm dia. bit	103.80	91	1.141
3.66 m drill rod	155.21	305	0.509
3.2 cm rope coupling	31.23	457	0.068
3.2 cm shank adaptor	157.64	914	0.173
Lubrication		Use	0.030
Bit sharpening		Use	0.131
		Total Cost/Meter	$2.052

6.2.4 STOPE DRILLING (BLASTHOLE)

Drill String	Unit Cost $/m	Perf. m	Cost/m $
110 mm/4") Bit	563.50	305	1.848
Hammer	3,705.00	7,620	0.486
1.5 m Drill Rod	340.00 ea.	700	0.486
Carrier Wear Parts	850.00	4,877	0.174
For Booster Compressor (high pressure air)			
Power and Electrical		Use	0.786
Air		Use	1.063
Installations		Use	1.181
Lubrication		Use	0.500
		Total Cost per Meter	$6.524

6.2.5 CABLE BOLTS (MECHANIZED CUT & FILL SECTION)

13m Bolts @ $1.80/m	= $23.40
9 Buttons (1.5m centres) $1.85 ea.	= $16.65
End Holding Device	= $ 2.35
	$42.40
Cement Grout 43.4 kg/hole @ $0.20/kg	= $ 8.68/hole

6.2.6 CABLE BOLTS (BLASTHOLE SECTION)

7.3 m Bolts $1.80/m	$13.14
5-Buttons ((1.5m centres) $1.85 each)	$ 9.25
End Holding Device	$ 7.35
Total Cost/cable bolt	$24.74
Cement Grout 24.4 kg/hole @ $0.20/kg	$ 4.88/hole

6.2.7 BLASTING

Trimtex		$3.28/kg
Nilite	(ANFO)	$0.553/kg
Tovex	(Water Gel)	$2.55/kg
Non-els	(Blasting Caps)	$1.82 each
Lead Line (14 ga)		$0.250/m
E.B. - Caps	(Electric Blasting Caps)	$8.33 each
Hang-up Explosives		$2.76/kg
Blockholing Explosives		$2.76/kg

6.2.8 DEVELOPMENT AND STOPE PIPE

Description	Length	Cost/Meter $
50 mm diameter	6.1 m	5.64
152 mm diameter	6.1 m	29.95
	Sub Total	$35.59

Couplings

Description	Length	Cost/Meter
50 mm	Used every 6.1 m	0.77
152 mm	Used every 6.1 m	2.29
	Sub Total	$ 3.06

Pipe Hangers (Install every 6.1 m)

Assume we drill 1 hole per rock bolt

Rock bolt 1.8 m long c/w nut, washer, plate @ $3.81 each

Cost/meter $0.63

0.64 m galvanized chain (1.5 m x $3.87 ÷ 6.1 m) $0.95

Sub Total $1.58

Total Cost/Meter for Development Pipe, Couplings and Hangers $40.23

Say $40.00

6.2.9 ROCKBOLTS (1.8m long)

Purchase price	$4.34 each
Drilling costs (from files)	$1.97/m

6.2.10 SCREEN

110 mm x 110 mm	28 m^3/roll
Cost/roll	$82.10

6.2.11 VENTILATION

Cost per meter for vent ducting	=	$18.05/m
Cost for metal clips (3 every 15.2m):		
3 x $2.00 each ÷ 15.2 m	=	$ 0.40/m
Total cost per meter:	=	$18.45/m

6.2.12 ALIMAK MAINTENANCE

Allow $50.00/m

6.2.13 CEMENT

Bulk Cement	$118.03/t

6.2.14 BULKHEAD MATERIALS

Timber	$ 0.44 per board foot
Reinforcing Steel 6 m	$ 4.82 each
Bull-horns	$18.90 each
Weeping tile	$ 0.85/m
Burlap	$ 2.33/m^2
Fabrene	$ 0.39/m^2

6.2.15 BACKFILL PIPE

Schedule 40 (6 inch diameter)
c/w couplings and hangers $33.82/m

6.2.16 ROADBED MATERIAL

Granular "A" Crushed Stone $3.60/t

6.2.17 JAW CRUSHER MAINTENANCE (Annual Operating & Maintenance Supplies)

Lubricants - 24 - 54 KC Kegs of EO-1 or 2		$ 3,216.72
Grease = 24 x 134.03/keg		
Crusher parts - Lower swing liners		6,635.00
- Lower fixed jaw plate		7,000.00
- Upper fixed liners - $6,000.00 ÷ 2		3,000.00
- Upper fixed jaw plate - $7,000.00 ÷ 4		1,750.00
- Cheek plates - lower - $961.00 ÷ 2		480.00
- upper - $1,500.00 ÷ 3		500.00
- Toggle seats - $7,500.00 ÷ 5		1,500.00
- Main bearing & pitman - $30,000.00 ÷ 30		1,000.00
- Jaw plate bolts - $1,600.00 ÷ 2		800.00
- Swing jaw bushings - $4,350.00÷ 5		870.00
- Lower fixed jaw plate retainer - $1,940.00÷ 3		646.67
- Tension rod springs - $920.00 ÷ 3		306.67
Crusher control chain and arc gate maintenance		5,200.00
Crusher chute liner maintenance		12,500.00
Drive belt replacement - $700.00 ÷ 5		140.00
Electrical maintenance	Say	5,000.00
Dust collector maintenance	Say	500.00
Overhead crane maintenance	Say	500.00
Miscellaneous cost	Say	3,500.00
	Total/Year	$55,045.06

6.2.18 STOPE CONVEYING MAINTENANCE

Assume 5% of capital costs as annual maintenance costs

Description	Width	Length (m)	Cost	Annual Cost
Ore bin feeder - 2 required			76,700.00	$ 3,835.00
Loading pocket conveyor	106.7cm	50.2m	87,300.00	4,365.00
Waste pass feeders - 1 required			38,300.00	1,915.00
			Total Cost	$10,115.00

6.2.19 SKIP MAINTENANCE: (2 Skips)

	Annual Cost
Skip door c/w rollers - $600.00 each x 2-skips	$ 1,200.00
Door liners - $300.00 each x 2-skips	600.00
Dump rollers - $300.00 each x 2-skips	600.00
Liners - $1,000.00 each x 2-skips	2,000.00
Guide rollers - $4,000.00 each x 2-skips	8,000.00
Guide slippers - $1,250.00 each x 2-skips	2,500.00
Total Skips	$14,900.00

6.2.20 CAGE MAINTENANCE:

Slippers	$ 1,100.00
Door	250.00
Main spring	300.00
Guide rollers	6,500.00
Total Cage	$ 8,150.00
Say	$ 8,200.00

6.2.21 LOADING POCKET MAINTENANCE

Liners - $3,334.00 each side x 2 sides	$ 6,668.00
Cylinder - $350.00 each side x 2 sides	700.00
Load cell - $600.00 each side x 2 sides	1,200.00
Total Loading Pkt.	$ 8,568.00
Say	$ 8,600.00

6.2.22 HEADFRAME BIN MAINTENANCE

Dump scrolls - $188.00 each side x 2 sides	$ 376.00
Liners	1,000.00
Spill chute	200.00
Total Bin	$ 1,576.00
Say	$ 1,600.00

6.2.23 COUNTER WEIGHT MAINTENANCE

Slippers	$ 275.00
Guide rollers	4,000.00
Total Counter Weight	$ 4,275.00
Say	$ 4,300.00

6.2.24 HEAD SHEAVES

3.05 m diameter - $3,500.00 each x 2 sheaves	$ 7,000.00
3.66 m diameter - $2,500.00 each x 2 sheaves	5,000.00
Total Head Sheaves	$12,000.00

6.2.25 SKIP HOIST MAINTENANCE

Say $19,800.00

6.2.26 CAGE HOIST MAINTENANCE

Say $19,800.00

6.2.27 ROPE USE AND ROPE MAINTENANCE

.1 Skip Ropes

890 Meters x 2 @ $20.38/m = $36,276.40
@ 2 - Year Life

Cost/Year $18,138.20
Say $18,100.00

.2 Cage Ropes

890 Meters x 2 @ $14.09/m = $25,080.20
@ 3 - Year Life $ 8,360.07
Say $ 8,400.00

.3 Rope Dressing

Say $ 2,100.00

.4 Lubricants

Say $ 4,000.00

.5 Shaft Maintenance

Distribution:

Guide replacement - 8 guides/mo.x12mo.x$235.00/guide	$22,560.00
Other maintenance	$12,800.00
Head Sheaves	$12,000.00

6.2.28 MINE SERVICES

a) Allow $50,000.00/year for total mine cleanup of ditches, sumps, etc.

b) Small Tools: - $250,000.00/year

c) Safety/Mine Rescue Supplies: $50,000.00/year

d) Cap Lamps: 100 lamps x $7.50/mo. x 12 mo./year = $9,000

6.2.29 FUEL

$0.29/litre for diesel fuel

6.2.30 TIRES

2 Boom Jumbo 1550 x 20 20 ply

	New	Recap 1	Recap 2	Recap 3
Tire price	$2,348	1,548	1,548	1,548
Tire life	10,000 hrs	8,000 hrs	8,000 hrs	8,000 hrs
Total cost		$6,992		
Total life		34,000 hrs		
Tire replacement cost/hour				$0.206

3.8m ^{3} Scooptram 1800 x 25

Tire price	$10,072	$5,852	$5,852	$5,852
Tire life	1,200 hrs	960 hrs	960 hrs	960 hrs
Total cost		$27,628		
Total life		4,080 hrs		
Tire replacement cost/hour				$6.772

6.2.30 TIRES (Cont'd)

Lube & Service Truck, Scissor Lifts, Powder Trucks
1000 x 20

	New	Recap 1	Recap 2	Recap 3
Tire price	$1,515	918	918	918
Tire life	2,000 hrs	1,600 hrs	1,600 hrs	1,600 hrs
Total cost		$4,269		
Total life		6,800 hrs		
Tire replacement cost/hour				$0.628

Blockhole Jumbo 16.9 x 24 rear
10.5 x 18 front

Tire price	1,138	Tires should last life of machine
Tire life	use 25,000 hrs.	
Tire replacement cost/hour		$0.046

Flatbeds, Graders 8.25 x 20

	New	Recap 1
Tire price	820	624
Tire Life	2,000 hrs	1,600 hrs.
Total cost		1,440
Total Life		3,600 hrs.
Tire Replacement cost/hour		$0.401

6.2.30 TIRES (Cont'd)

Utility Vehicle 700 x 15

	New	Recap 1	Recap 2	Recap 3	
Tire price	635	423	423	423	
Tire life	2,000 hrs	1,600 hrs	1,600 hrs	1,600 hrs	
Total cost		$1,904			
Total life		6,800 hrs			
Tire replacement cost/hour					$0.280

Roof - Bolting Jumbo 1200 x 2400 20 ply

Tire price	3,252	2,164	2,164	2,164	
Tire life	2,000 hrs	1,500 hrs	1,500 hrs	1,500 hrs	
Total cost		$9,744			
Total life		6,500 hrs			
Tire replacement cost/hour					$1.499

Small Loader 15.5 x 2500

Tire price	2,216	1,208	1,208	1,208	
Tire life	2,000 hrs	1,600 hrs	1,600 hrs	1,600 hrs	
Total cost		$5,840			
Total life		6,800 hrs			
Tire replacement cost/hour					$0.859

6.2.30 TIRES (Cont'd)

Rock Breaker 1800 x 25

	New	Recap 1	Recap 2	Recap 3
Tire price	10,072	5,852	5,852	5,852
Tire life	2,000 hrs	1,600 hrs	1,600 hrs	1,600 hrs
Total cost		$27,628		
Total life		6,800 hrs		
Tire replacement cost/hour				$4.063

6.2.31 AIR HEATING

Propane Fuel $0.23/litre

6.2.32 PUMPING

Packing		$ 113.33
Suction sleeve		52.00
Delivery sleeve		48.50
Bearing		121.00
Balance valve		86.25
Seating and bushing		79.00
Neck ring		164.25
Neck bushing		128.00
Impeller		668.25
	Total Cost/Year/Pump	1,460.58
	Total Cost/Year for 2 Pumps	2,921.16
	Say	$3,000.00

6.2.33 ELECTRIC POWER

Power costs for complete mine are calculated to be $60,000 per month.

6.2.34 VENTILIATION

Operating and Maintenance Supplies:

Repairs to ventilation doors (15) and regulators (7), materials only

22 doors + regulators x $500.00 ea/year		$11,000.00
Repair fans - 16 x $1,000.00/year		16,000.00
Heaters		8,000.00
	Total	$35,000.00

6.2.35 RAIL HAULAGE

Operating and Maintenance Supplies		Cost/Year
A) Balco 8-Ton Battery Locomotives (2)		
Batteries - $\frac{18 \text{ batteries} \times \$11,700 \text{ battery}}{20 \text{ years}}$		$10,530.00
Replacement parts $150/week x 52 weeks/year		7,800.00
	Sub Total	$18,330.00
B) D.O.L. - 10 Tonne O&K Cars		
Wheels - $600.00/wheel x 15 wheels/year		$ 9,000.00
Liners - $5,000.00/car x 2 cars/year		10,000.00
Dump track - $10,000 @ 10 year life		1,000.00
Door rollers - replace - $\frac{3 \times \$1,000 \text{ each}}{4 \text{ year life}}$		750.00
Dump rollers - 6/year x $600.00 each		3,600.00
	Sub Total	$24,350.00
C) O&K Ore Pass Dump (1)		
$60,000 @ 20%/year	Sub Total	$12,000.00
D) LKAB - Ore Pass Chutes (4)		
4 x $30,000 @ 20%/Year	Sub Total	$24,000.00
E) Rail, Angle Bars, Ties, Etc.		
912 meters x $57.00/m @ 2%/year	Sub Total	$ 1,040.00
F) Switches		
4 x $4,600.00 @ 2%/year	Sub Total	368.00
	Total/Year	$80,088.00

6.2.36 ORE PASSES

Dumps for MCF Section		Cost/Year
Yearly cost @ $2,000/dump for repair of dust door and concrete	16 dumps	$32,000
Cost/tonne @ 486,545 t/year = 0.066		
Dumps for BHS Section		
4 sumps @ $30.00/dump		$12,000
Cost/tonne @ 425,955 t/year = 0.028		

6.2.37 DIAMOND DRILLING

Assume diamond drilling by outside Contractor at quoted price of $30/m.

6.2.38 MAINTENANCE SUPPLIES FOR MOBILE EQUIPMENT

Maintenance supplies for mobile equipment are, typically, highly variable from one mining operation to another. For this operation estimated costs are based on allowing a certain proportion of total costs to be for supplies and the remainder for labour. The proportions are developed from experience in similar operations.

Assumptions:

Mobile equipment maintenance costs are made up of: 55% labour
45% supplies

Labour is .75 men/unit of mobile equipment

Calculations:

For mechanized cut & fill section there are 18 pieces of mobile equipment

Maintenance labour is 18 x .75 = 14 men
@ $219.40/day = $3,071.60/day

Therefore, supplies = $\frac{\$3,071.60 \times .45}{.55}$ = $2,513.13/day

or $1.885/t

For blasthole stope section there are also 18 pieces of mobile equipment

Therefore, labour is $3,071.60/day

and supplies are $2,513.13/day

or $2.154/t

6.3 OPERATING COST SUMMARIES

We are now in a position to summarize all the foregoing information and develop combined operating cost summaries for the mine.

6.3.1 LABOUR

From the manpower summaries given in Part 4 and the unit costs presented in this Part 6, Table 6-2 summarizes labour costs for the mechanized cut and fill section and Table 6-3 giving the same information for the blasthole stope section were prepared.

TABLE 6-2 MECHANIZED CUT & FILL (1333 t/day)

LABOUR COST SUMMARY

DIRECT

Activity	Daily Operating Labour (from Table 4-7) manshifts/day	Daily Maintenance Labour (from Table 4-6) manshifts/day	Total	Daily Cost @ $219.40 per manshift	Cost/t
Mine Development	2.0	*0.66	2.66	583.60	0.44
Stope Development	9.5	3.53	13.03	2,852.20	2.14
Stope Drilling 51 mm	3.0	*0.77	3.77	827.14	0.62
Stope Blasting	1.0	0.75	1.75	383.95	0.29
Stope Mucking	2.5	1.65	4.15	910.51	0.68
Ground Control	8.0	1.50	9.50	2,084.30	1.56
Backfill	2.0	0.38	2.38	522.17	0.39
Roadbed Maintenance	1.0	0.38	1.38	302.77	0.23
Underground Jaw Crusher	1.0	1.50	2.50	548.50	0.41
Conveying	1.5	0.38	1.88	412.47	0.31
Hoisting	5.0	1.50	6.50	1,426.10	1.07
Mine Services	11.0	3.00	14.00	3,071.60	2.30
Fuel	0.5		0.5	109.70	0.08
Tires	0.5		0.5	109.70	0.08
Mine Air Heating	-		-	-	-
Pumping	0.5		0.5	109.70	0.08
Electric Power	-	2.5	2.5	548.50	0.41
Ventilation	0.5	0.5	1.0	219.40	0.16
Rail Haulage	1.0	1.0	2.0	438.80	0.33
Ore Passes	-	-	-	-	-
Diamond Drilling (Subcontract)	-	-	-	-	-
	50.5	20.00	70.50	15,461.30	11.58

INDIRECT

				DAILY COST FOR ALL MINE	
Management & Engineering		See 6.1.1		1,981.87	0.793
Operations	5.0	-	5.0	1,457.47	0.583
Maintenance	-	2.5	2.5	728.32	0.291
				4,167.66	1.667

Operating Labour $11,075/day or $8.30/t (71%)
Maintenance Labour $ 4,386/day or $3.28/t (29%)
*Rounded to give even number total.

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TABLE 6-3 BLASTHOLE STOPING (1167 t/day)
LABOUR COST SUMMARY
DIRECT

Activity	Daily Operating Labour (from Table 4-7) manshifts/day	Daily Maintenance Labour (from Table 4-6) manshifts/day	Total	Daily Cost @ $219.40 per manshift	Cost/t
Mine Development	2.0	*0.75	2.75	603.35	0.52
Stope Development	6.5	2.69	9.19	2,016.29	1.73
Stope Drilling 110 mm	2.0	0.90	2.90	636.26	0.55
Stope Blasting	1.0	-	1.0	219.40	0.19
Stope Mucking	1.5	0.84	2.34	513.40	0.44
Secondary Blasting	2.0	0.75	2.75	603.35	0.52
Ground Control	1.0	0.75	1.75	383.95	0.33
Backfill	4.0	2.06	6.06	1,329.56	1.14
Roadbed Maintenance	1.0	0.38	1.38	302.77	0.26
Underground Jaw Crusher	1.0	1.50	2.50	548.50	0.47
Conveying	1.5	0.38	1.88	412.47	0.35
Hoisting	5.0	1.50	6.50	1,426.10	1.22
Mine Services	11.0	*2.50	13.50	2,961.90	2.54
Fuel	0.5	-	0.5	109.70	0.09
Tires	0.5	-	0.5	109.70	0.09
Mine Air Heating	-	-	-	-	-
Pumping	0.5	-	0.5	109.70	0.09
Electric Power	-	2.5	2.5	548.50	0.47
Ventilation	0.5	0.5	1.0	219.40	0.19
Rail Haulage	1.0	1.0	2.0	438.80	0.38
Ore Passes	-	-	-	-	
Diamond Drilling (Subcontract)	-	-	-	-	-
	42.5	19.0	61.5	13,493.06	11.57

INDIRECT

				DAILY COST FOR ALL MINE	
Management & Engineering	See 6.1.1			1,981.87	0.793
Operations	5.0	-	5.0	1,457.47	0.583
Maintenance	-	2.5	2.5	728.32	0.291
				4,167.66	1.667

Operating Labour $9,324.47/day or $7.99/t (69%)
Maintenance Labour $4,168.58/day or $3.58/t (31%)
*Rounded to give even number total.

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6.3.2 OPERATING SUPPLIES

Table 6-4 summarizes operating supplies costs for the mechanized cut and fill section of the mine and Table 6-5 covers the blasthole stope section for each major operation. These tables also show costs expressed on a unit basis. References for locating the derivation of quantities and unit prices are shown in parentheses.

TABLE 6-4 OPERATING SUPPLIES MECHANIZED CUT & FILL SECTION

Activity	Sub-Section	Annual Quantity	Unit Price $	Annual Cost $	Unit Cost $/t
Mine Development + (Quantities relate to both MCF and BHS Sections)	Drilling	44,104 m (3.1.2)	1.82 (6.2.2)	80,269	
		1,573 m (3.1.8)	1.97 (6.2.2)	3,099	
	Blasting - Nilite	46,856 kg (3.1.3)	0.553 (6.2.7)	25,911	
	- Tovex	6,300 kg and	2.52 (6.2.7)	15,876	
	- Non Els	11,723 (3.1.8)	1.82 (6.2.7)	21,336	
	Pipework	949 m (3.1.4)	40.00 (6.2.8)	37,960	
	Ground Support - Bolts	1,386 (3.1.5)	4.34 (6.2.9)	6,015	
	- Drilling	3,326 m (3.1.5)	1.97 (6.2.9)	6,552	
	Ventilation	949 m (3.1.6)	18.45 (6.2.11)	17,509	
	Alimak Maintenance	43 m (3.1.8)	50.00 (6.2.12)	2,150	
			Sub Total	216,677	0.238
			(Daily Cost $549)		
Stope Development (Stope Levels)	Drilling	103,998 m (3.2.3)	1.82 (6.2.2)	189,276	
	* Blasting - Nilite	119,267 kg (3.2.3)	0.553 (6.2.7)	65,955	
	- Tovex	15,931 kg (3.2.3)	2.52 (6.2.7)	40,146	
	- Non Els	29,562 (3.2.3)	1.82 (6.2.7)	53,803	
	Pipework	1,178 m (3.2.3)	40.00 (6.2.8)	47,120	
	Ground Support - Bolts	3,129 (3.2.3)	4.34 (6.2.9)	13,580	
	- Drilling	7,510 m (3.2.3)	1.97 (6.2.9)	14,795	
	Ventilation	1,178 m (3.2.3)	18.45 (6.2.11)	21,734	
	Alimak Maintenance	126 m (3.2.3)	50.00 (6.2.12)	6,300	
			Sub Total	452,709	0.930
			(Daily Cost $1,240)		
Stope Drilling (51 mm)		144,220 m (3.2.6)	2.052 (6.2.3)	295,939	0.608
			(Daily Cost $810)		
Stope Blasting	* Trimtex	11,761 kg (3.2.6)	3.28 (6.2.7)	38,576	
	* Nilite	200,520 kg (3.2.6)	0.553 (6.2.7)	100,888	
	* Tovex	21,547 kg (3.2.6)	2.52 (6.2.7)	54,298	
	* Non Els	46,661 kg (3.2.6)	1.82 (6.2.7)	84,923	
			Sub Total	288,685	0.593
			(Daily Cost $791)		

* These quantities include 10% allowance for miscellaneous items.
\+ Activities marked this relate to both sections of mine and costs are derived by dividing by total mine production.

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TABLE 6-4 OPERATING SUPPLIES MECHANIZED CUT & FILL SECTION (Cont'd)

Activity	Sub-Section	Annual Quantity	Unit Price $	Annual Cost $	Unit Cost $/t
Stope Ground Control	Rock Bolts	11,575 m (3.2.8)	4.34 (6.2.9)	50,235	
	Drilling	20,835 m (3.2.8)	1.97 (6.2.9)	41,044	
	Cable Bolts	5,220 (3.2.8)	42.40 (6.2.5)	221,328	
	Drilling	67,860 m (3.2.8)	1.97 (6.2.9)	133,684	
	Grout	5,220 (3.2.8)	8.68 (6.2.5)	45,310	
	Screen	53 rolls (3.2.8)	82.10 (6.2.10)	4,351	
			Sub Total	496,953	1.019
			(Daily Cost $1,359)		
Stope Backfill	Timber	5,908 BF (3.2.9)	0.44 (6.2.14)	2,599	
	Rebar	40 (3.2.9)	4.82 (6.2.14)	192	
	Drilling	24 m (3.2.9)	1.97 (6.2.9)	47	
	Bullhorns	60 (3.2.9)	18.90 (6.2.14)	1,134	
	Drilling	72 m (3.2.9)	1.97 (6.2.9)	142	
	Weeping Tile	-	-	30	
	Burlap	12 m^2 (3.2.9)	2.33 (6.2.14)	28	
	Fabrene	46 m^2 (3.2.9)	0.39 (6.2.14)	18	
	Cement in Cap	1,725 t (3.2.9)	118.03 (6.2.13)	203,601	
	Cement in Crown Pillar	995 t (3.2.9)	118.03 (6.2.13)	117,439	
	Backfill Pipe	642 m (3.2.9)	33.82 (6.2.15)	21,712	
			Sub Total	346,942	0.713
			(Daily Cost $951)		
Roadbed +	Mine Development	920 t (3.2.10)	3.60 (6.2.16)	3,312	
	Replacement	92 t (3.2.10)	3.60 (6.2.16)	331	
			Sub Total	3,643	0.004
			(Daily Cost $10)		
U/G Jaw Crusher			(6.2.17)	55,045	0.060
			(Daily Cost $151)		
Stope Conveying +			(6.2.18)	10,115	0.011
			(Daily Cost $28)		
Hoisting +			(6.2.19 to 6.2.27)	169,160	0.185
			(Daily Cost $463)		

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TABLE 6-4 OPERATING SUPPLIES MECHANIZED CUT & FILL SECTION (Cont'd)

Activity	Sub-Section	Annual Quantity	Unit Price $	Annual Cost $	Unit Cost $/t
Mine Services + (Annual costs)			(6.2.28) (Daily Cost $984)	359,000	0.393
Fuel (Daily quantity)		2,553 L (3.2.15)	0.29 (6.2.29)	740	0.555
Tires (Daily usage)	2 Boom Jumbos	6 hr (3.2.16)	0.206 (6.2.30)	1	
	3.8 m^3 Scoops	51 hr (3.2.16)	6.772 (6.2.30)	345	
	Flatbed Trucks	14 hr (3.2.16)	0.401 (6.2.30)	6	
	Roof Bolting Jumbo	7 hr (3.2.16)	1.499 (6.2.30)	11	
	Scissor-Lift Truck	14 hr (3.2.16)	0.628 (6.2.30)	9	
	Grader	3.5 hr (3.2.16)	0.401 (6.2.30)	1	
	Utility Vehicle	3.5 hr (3.2.16)	0.280 (6.2.30)	1	
	Lube & Service Truck	3.5 hr (3.2.16)	0.628 (6.2.30)	2	
	Loader	3.5 hr (3.2.16)	0.859 (6.2.30)	3	
	Powder Truck	17.5 hr (3.2.16)	0.628 (6.2.30)	11	
			Sub Total	390	0.293
Air Heating (Annual quantity)	Propane	1,263,460 L (3.2.17)	0.23 (6.2.31) (Daily Cost $796)	290,596	0.597
Pumping +				3,000 (6.2.32) (Daily Cost $8)	0.003
Electric Power +		12 mths	60,000/mth (6.2.33) (Daily Cost $1,973)	720,000	0.789
Ventilation +				35,000 (6.2.34) (Daily Cost $96)	0.038
Rail Haulage +				80,088 (6.2.35) (Daily Cost $219)	0.088
Ore Passes +				32,000 (6.2.36) (Daily Cost $88)	0.035
Diamond Drilling +		30,000 m (3.2.24)	30.00/m (6.2.37) (Daily Cost $2,466)	900,000	0.986
				Total	$8.138/t

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TABLE 6-5 OPERATING SUPPLIES BLASTHOLE SECTION

Activity	Sub-Section	Annual Quantity	Unit Price $	Annual Cost $	Unit Cost $/t
Mine Development (Quantities relate to both MCF and BHS Sections)	Drilling	44,104 m (3.1.2)	1.82 (6.2.2)	80,269	
		1,573 m (3.1.8)	1.97 (6.2.2)	3,099	
	Blasting - Nilite	46,856 kg (3.1.3)	0.553 (6.2.5)	25,911	
	- Tovex	6,300 kg and	2.52 (6.2.5)	15,876	
	- Non Els	11,723 (3.1.8)	1.82 (6.2.5)	21,336	
	Pipework	949 m (3.1.4)	40.00 (6.2.6)	37,960	
	Ground Support - Bolts	1,386 m (3.1.5)	4.34 (6.2.7)	6,015	
	- Drilling	3,326 m (3.1.5)	1.97 (6.2.8)	6,552	
	Ventilation	949 m (3.1.6)	18.45 (6.2.9)	17,509	
	Alimak Maintenance	43 m (3.1.8)	50.00 (6.2.10)	2,150	
			Sub Total	216,677	0.238
			(Daily Cost	$594)	
Stope Development (Stope blocks)	Drilling	82,011 m (3.3.4)	1.82 (6.2.2)	149,260	
	Blasting - Nilite	95,439 kg (3.3.4)	0.553 (6.2.7)	52,778	
	- Tovex	12,748 kg (3.3.4)	2.52 (6.2.7)	32,125	
	- Non-Els	23,656 (3.3.4)	1.82 (6.2.7)	43,054	
	Pipework	1,885 m (3.3.4)	40.00 (6.2.8)	75,400	
	Ground Support Bolts	2,503 (3.3.4)	4.34 (6.2.9)	10,863	
	Drilling	6,009 m (3.3.4)	1.97 (6.2.9)	11,838	
	Ventilation	1,885 m (3.3.4)	18.45 (6.2.11)	34,778	
			Sub Total	410,096	0.963
			(Daily Cost	$1,124)	
Stope Drilling (110 mm)		28,186 m (3.3.5)	6.524 (6.2.4)	183,855	0.431
			(Daily Cost	$504)	
Stope Blasting	* Nilite	83,346 kg (3.3.6)	0.553 (6.2.7)	46,090	
	* Tovex	83,346 kg (3.3.6)	2.52 (6.2.7)	210,032	
	* Non-Els	1,122 (3.3.6)	1.87 (6.2.7)	2,042	
	* Lead-line	6,545 m (3.3.6)	0.250 (6.2.7)	1,636	
	* E.B. Caps	486 (3.3.6)	8.33 (6.2.7)	4,048	
			Sub Total	263,848	0.620
			(Daily Cost	$723)	
Secondary Blasting	* Hang-ups Explosives	37,043 (3.3.8)	2.76 (6.2.7)	102,239	
	* Non Els	31,355 (3.3.8)	1.82 (6.2.7)	57,066	
	* Blockholing Explosives	18,522 kg (3.3.8)	2.76 (6.2.7)	51,121	

* These quantities include 10% allowance for miscellaneous items
+ Activities marked this relate to both sections of the mine and unit costs are derived by dividing by total mine production.

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TABLE 6-5 OPERATING SUPPLIES BLASTHOLE SECTION (Cont'd)

Activity	Sub-Section	Annual Quantity	Unit Price $	Annual Cost $	Unit Cost $/t
	Drilling	16,508 m (3.3.8)	1.97 (6.2.9)	32,521	
			Sub Total	242,947	0.571
			(Daily Cost	$666)	
Ground Control	Rock Bolts	2,504 (3.3.9)	4.34 (6.2.9)	10,867	
	Drilling	6,011 m (3.3.9)	1.97 (6.2.9)	11,842	
	Cable Bolts	969 (3.3.9)	24.74 (6.2.6)	23,973	
	Drilling	7,074 m (3.3.9)	1.97 (6.2.9)	13,936	
	Grout	969 (3.3.9)	4.88 (6.2.6)	4,729	
			Sub Total	65,347	0.153
			(Daily Cost	$179)	
Stope Backfill	Timber	42,685 BF (3.3.10)	0.44 (6.2.14)	18,781	
	Rebar	289 (3.3.10)	4.82 (6.2.14)	1,393	
	Drilling	173 m (3.3.10)	1.97 (6.2.9)	341	
	Bullhorns	434 (3.3.10)	18.90 (6.2.14)	8,203	
	Drilling	520 m (3.3.10)	1.97 (6.2.9)	1,024	
	Weeping Tile	-	-	220	
	Burlap	87 m^2 (3.3.10)	2.33 (6.2.14)	203	
	Fabrene	332 m^2 (3.3.10)	0.39 (6.2.14)	130	
	Cement in Fill	1,105 t (3.3.10)	118.03 (6.2.13)	130,423	
	Backfill Pipe	6 m (3.3.10)	33.82 (6.2.15)	203	
			Sub Total	160,921	0.378
			(Daily Cost	$441)	
Roadbed +	Mine Development	920 t	3.60 (6.2.16)	3,312	
	Replacement	92 t	3.60 (6.2.16)	331	
	Stope Development	125 t (3.3.11)	3.60 (6.2.16)	450	
				4,093	0.009
			(Daily Cost	$11)	
U/G Jaw Crusher +			(6.2.17)	55,045	0.060
			(Daily Cost	$151)	
Stope Conveying +			(6.2.18)	10,115	0.011
			(Daily Cost	$28)	
Hoisting +			(6.2.19 to 6.2.27)	169,160	0.185
			(Daily Cost	$463)	

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TABLE 6-5 OPERATING SUPPLIES BLASTHOLE SECTION (Cont'd)

Activity	Sub-Section	Annual Quantity	Unit Price $	Annual Cost $	Unit Cost $/t
Mine Services			(6.2.28) (Daily Cost	359,000.00 $984)	0.393
Fuel (Daily quantity)		2,509 l (3.3.13)	0.29 (6.2.29)	728	0.624
Tires (Daily usage)	2 Boom Jumbos	6 hr (3.3.15)	0.206 (6.2.30)	1	
	3.8 m^3 Scooptrams	51 hr (3.3.15)	6.772 (6.2.30)	345	
	Flatbed Trucks	21 hr (3.3.15)	0.401 (6.2.30)	8	
	Blockhole Drill	7 hr (3.3.15)	0.046 (6.2.30)	1	
	Roof Bolting Jumbo	7 hr (3.3.15)	1.499 (6.2.30)	10	
	Scissor Lift	7 hr (3.3.15)	0.628 (6.2.30)	4	
	Grader	3.5 hr (3.3.15)	0.401 (6.2.30)	2	
	Utility Vehicle	3.5 hr (3.3.15)	0.280 (6.2.30)	1	
	Lube & Service Truck	3.5 hr (3.3.15)	0.628 (6.2.30)	3	
	1.8 m^3 Loader	3.5 hr (3.3.15)	0.859 (6.2.30)	3	
	Powder Trucks	10.5 hr (3.3.15)	0.628 (6.2.30)	7	
			Sub Total	383	0.328
Air Heating (Annual quantity)	Propane	1,242,738 l (3.3.16)	0.23 (6.2.31) (Daily Cost	285,830 $783)	0.671
Pumping +				3,000.00 (6.2.32) $8)	0.003
Electric Power +		12 mths	(Daily Cost 60,000/mth (6.2.33)	720,000.00	0.789
Ventilation +			(Daily Cost	$1,973)	
Rail Haulage +			(Daily Cost	35,000.00 (6.2.34) $96)	0.038
Ore Passes +			(Daily Cost	80,088.00 (6.2.35) $219)	0.088
Diamond Drilling +		30,000 m (3.2.25)	(Daily Cost 30.00/m(6.2.37) (Daily Cost	32,000.00 (6.2.36) $88) 900.00 (6.2.37) $2,466)	0.035 0.986
				Total Operating Supplies	7.574 t

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6.3.5 TOTAL COSTS

Table 6-6 shows the operating costs for each mining activity and mining section and includes the indirect costs. Table 6-7 summarizes these costs and presents daily totals under the major headings commonly used in the mining industry.

TABLE 6-6
UNIT OPERATING COST SUMMARIES FOR
BOTH MINING SECTIONS
($/t ORE)

ACTIVITY	MCF SECTION			BHS SECTION		
DIRECT	LABOUR	SUPPLIES	TOTAL	LABOUR	SUPPLIES	TOTAL
Mine Development	0.44	0.238	0.678	0.52	0.238	0.758
Stope Development	2.14	0.930	3.070	1.70	0.963	2.693
Stope Drilling 51mm	0.62	0.608	1.228	-	-	-
Stope Drilling 110 mm	-	-	-	0.55	0.431	0.981
Stope Blasting	0.29	0.593	0.883	0.19	0.620	0.810
Stope Mucking	0.68	-	0.680	0.44	-	0.440
Secondary Blasting	-	-	-	0.52	0.571	1.091
Ground Control	1.56	1.019	2.579	0.33	0.153	0.483
Backfill	0.39	0.713	1.103	1.14	0.378	1.518
Roadbed Maintenance	0.23	0.004	0.234	0.26	0.004	0.264
Underground Jaw Crusher	0.41	0.060	0.470	0.47	0.060	0.530
Conveying	0.31	0.011	0.321	0.35	0.011	0.361
Hoisting	1.07	0.185	1.255	1.22	0.185	1.405
Mine Services	2.30	0.393	2.693	2.54	0.393	2.933
Fuel	0.08	0.555	0.635	0.09	0.624	0.714
Tires	0.08	0.293	0.373	0.09	0.328	0.418
Mine Air Heating	-	0.597	0.597	-	0.671	0.671
Pumping	0.08	0.003	0.083	0.09	0.003	0.093
Electric Power	0.41	0.789	1.199	0.47	0.789	1.259
Ventilation	0.16	0.038	0.198	0.19	0.038	0.228
Rail Haulage	0.33	0.088	0.418	0.38	0.088	0.468
Ore Passes	-	0.035	0.035	-	0.035	0.035
Diamond Drilling	-	0.986	0.986	-	0.986	0.986
Maintenance Supplies	-	1.885	1.885	-	2.154	2.154
SUB	11.58	10.023	21.603	11.57	9.728	21.298
INDIRECT						
Management & Engineering	0.793	1.617	2.410	0.793	1.617	2.410
Operations Supervision	0.583	-	0.583	0.583	-	0.583
Maintenance Supervision	0.291	-	0.291	0.291	-	0.291
SUB	1.667	1.617	3.284	1.667	1.617	3.284
TOTAL	13.247	11.640	24.887	13.327	11.345	24.582

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TABLE 6-7 SUMMARY OF DAILY OPERATING COSTS

Item	MCF Section $/t	BHS Section $/t	Daily Total MCF	Daily Total BHS	Daily Total
Direct					
Operating Labour (Tables 6-3, 6-4)	8.30	7.99	11,064	9,324	20,388
Maintenance Labour (Table 6-3, 6-4)	3.28	3.58	4,372	4,177	8,549
Operating Supplies and Services (Tables 6-4, 6-5)	8.138	7.574	10,848	8,839	19,687
Maintenance Supplies and Services (Table 6-6)	1.885	2.154	2,513	2,514	5,027
Indirect					
Management and Engineering (Table 6-6)	0.793	0.793	1,057	925	1,982
Support Services	1.617	1.617	2,155	1,887	4,042
Operations Supervision	0.583	0.583	777	680	1,457
Maintenance Supervision	0.291	0.291	388	339	727
	24.887	24.582	33,174	28,685	61,859

PART 7
UNIT COSTS AND SENSITIVITY ANALYSES

7.1 GENERAL

Costs were developed and summarized in Part 6 on the basis of the tonnage of ore produced by the two mining methods. This part of the report expresses some of those unit costs on different bases in order that they may be compared more readily with cost data from other mining operations. We have also reformatted the costs to suit the data base which was developed for the project. Once again, comparison with other mining operations was in mind while developing the software containing this data base.

The data base file contains the following information:

FIELDS (HORIZONTAL TITLES)

Mine/Method

Production Rate

Key

Activity

Sub Activity

Operating Labour Man Shifts/Day

Maintenance Labour Man Shifts/Day

Total Labour Man Shifts/Day

Cost/Man Shift

Daily Labour Cost

Labour Cost/Tonne

Supplies Annual

Supplies Annual Cost

Supplies Cost/Tonne

Total Cost/Tonne

% Total Mining Cost

Other Unit

Cost/Other Unit

LIST OF RECORD LABELS (VERTICAL TITLES)

1.0	Mine Development	Total
.1		Drill
.2		Blast
.3		Mucking
.4		Ground Support
.5		Ventilation and Pipe
.6		Alimak Maintenance
2.0	Stope Development	Total
.1		Drill
.2		Blast
.3		Mucking
.4		Ground Support
.5		Ventilation and Pipe
.6		Alimak Maintenance
3.0	Stoping	Total
.1		Drill 51 mm
.2		Drill 110 mm
.3		Blast
.4		Stope Muck
.5		2nd Blast
.6		Ground Support
.7		Backfill
4.0	Road Maintenance	Total
.1		Mine Development
.2		Stope Development
.3		Replacement
5.0	Underground Crushing	

LIST OF RECORD LABELS (VERTICAL TITLES) (Cont'd)

6.0	Conveying	
7.0	Rail Haulage	
8.0	Mobile Equipment	Total
.1		Fuel
.2		Tires
.3		Maintenance
9.0	Conveying	
10.0	Ore Pass	
11.0	Hoisting	
12.0	Diamond Drill	
13.0	Mine Services	
14.0	Pumping	
15.0	Ventilation	
16.0	Heating	
17.0	Electric Power	
18.0	Indirects	Total
.1		Management and Engineering
.2		Operating Supplies
.3		Maintenance Supplies
19.0	Total Costs	

7.2 UNIT COSTS

Table 7-1 shows unit costs for certain capital items and operating costs expressed on a bases other than dollars per tonne of ore produced. This has been done in order that certain costs can be compared with those from other properties more readily. The items selected for addressing in this way are not, of course, a complete list but they do cover the items more commonly expressed as a cost per different unit.

TABLE 7-1
UNIT COSTS ON BASIS OTHER THAN DOLLARS/TONNE ORE PRODUCED

CAPITAL COSTS

ITEM	TOTAL/COST	COST($)/DAILY TONNE OF ORE	QUANTITY OTHER UNIT	COST($)/OTHER UNIT
Mining Equipment for MCS Section (1,333 tpd)	3,458,000	2,594		
Mining Equipment for BHS Section (1,167 tpd)	3,735,000	3,201		
Surface Facilities (2,500 tpd)	17,682,000	7,073		
Shaft Sinking (2,500 tpd)	7,887,000	3,155	710 m	11,109/m
Mine Services (2,500 tpd)	6,737,000	2,695		
Lateral Development (2,500 tpd)	27,275,000	10,910	45,812 m	595/m
Raise Boring	1,650,000	660	1,513 m	1,090/m

OPERATING COSTS

ITEM	COST/TONNE ORE LABOUR	COST/TONNE ORE SUPPLIES	DAILY COSTS	DAILY QUANTITY OTHER UNIT	COST($)/OTHER UNIT
Mine Development	0.480	0.238	1,795	2.72 m	660/m
Stope Development (MCF Section)	2.140	0.930	4,092	6.80 m	602/m
Stope Development (BHS Section)	1.730	0.963	3,143	5.17 m	608/m

7.3 SENSITIVITY ANALYSES

Table 7-2 shows the results of simple sensitivity analyses carried out to test the effect of changing prices for supplies and services or changing labour rates. The table shows the effect on the costs of a particular activity by changing the identified variable only, by an amount of 10%; the effect on the cost producing a tonne of ore is also identified.

TABLE 7-2
SENSITIVITY ANALYSES

ACTIVITY (IES)	VARIABLE CHANGED 10%	PERCENTAGE CHANGE IN COST OF ACTIVITY(IES)	PERCENTAGE CHANGE IN COST OF PRODUCING ORE
All operations	Labour costs (Direct and Indirect)	10.00	5.34
Mine Development	Explosives Costs	2.91	0.03
	Drilling Supplies	3.85	0.04
Stope Development	Explosives Costs	3.52	0.13
	Drilling Supplies	4.20	0.16
Stope Blasting	Explosives Costs	10.00	0.24
All Blasting	Explosives Costs	10.00	0.40
Stope Drilling (Average of MCF and BHS drilling)	Drilling Supplies	10.00	0.21
All Drilling	Drilling Supplies	10.00	0.41
MCF Stope Ground Control	All Supplies	10.00	0.04
BHS Stope Ground Control	All Supplies	10.00	0.06
Stope Backfill (Average of MCF and BHS backfill)	Cement	8.88	0.16
Fuel (Average of MCF and BHS sections)	Diesel	10.00	0.24
Electric Power	Power	10.00	0.32
Diamond Drilling	Subcontract Price	10.00	0.40